SMITHSONIAN DEPOSIT
NOV 10 1902
LIBRARY OF CONGRESS

THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXVII. No. 19. Whole No. 1,431. | NEW YORK, MONDAY, NOVEMBER 10, 1902. | $3 PER ANNUM. IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told..... 661

The Fifth Annual Meeting of the Kansas Gas, Water and Electric Light Association—A Point Well Taken—Notes.

Solders for Tin, Cast Iron and Copper..... 662

Proceedings, Thirtieth Annual Meeting, American Gas Light Association—Limited Abstract—Continued from Page 626..... 662

First Day, Morning Session—Report of Committee on a Uniform System of Accounts for Gas Companies—The Junior System of Accounts—Discussion—Report of Committee on Research—Committee on Place of Next Meeting—A Brace of Invitations—*Some Notes on Cement Masonry, by Mr. I. N. Knapp—Discussion.

Hot Water Heating from a Central Station, by Mr. E. H. McKnight 673

Pumps and Other Mechanical Accessories in Electro Chemical Plants..... 674

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 674

Mr. M. H. Spear Goes to Flushing, N. Y.—Contract for Adam Weber Sons—Annual Meeting, Consumers Gas Company, Toronto—An Interesting Decision—Another Baltimore Correspondent Heard from—Something from Centralia, Ills.—The Logan Natural Gas Company Purchases Some Artificial Plants in Ohio—The Swedesboro (Pa.) Gas Company—Death of Mr. H. D. Kampman—The Old Auburn (N. Y.) Company Explains—Tinkering with Gas Rates, Lincoln, Ills.—Proposed Plant for Fairbury, Ills.—The New Management, Albion, Mich.—And Other Items.

The Market for Gas Securities..... 676

BRIEFLY TOLD.

THE FIFTH ANNUAL MEETING OF THE KANSAS GAS, WATER AND ELECTRIC LIGHT ASSOCIATION.—The fifth annual meeting of the Kansas Gas, Water and Electric Light Association will be held in Newton, Kas., to-morrow. The sessions, which are to be completed in a single day, according to the programme, will fairly bristle with technical activity, and the ordinary observer may be forgiven for thinking, or at least fearing, that something will have to be slighted if the programme mapped out is carried to a conclusion. The headquarters of the Association are to be in the Arcade Depot Hotel, and the sessions are to be held in the City Council Chamber, under the direction of the President, Mr. W. G. Seabury, of Pittsburg, Kas., and his chief lieutenant will be the Association's efficient Secretary-Treasurer, Mr. S. W. Sterrett, of Kansas City, Kas. The paper list calls for the presentation of the following numbers: President's Address; "The Economy of Reconstructing Central Stations to Modern Methods," by Mr. C. R. Maunsell, of Topeka, Kas.; "The Nernst Lamp," by Prof. Lucien I. Blake, of Lawrence, Kas.; "Rotary Pumping," by Mr. Wynkoop Kiersted, of Kansas City, Mo.; "Recent Developments in the Direction of Economy and Variety of Fuel," by Prof. E. H. S. Bailey, of Lawrence, Kas.; "System of Charging," by Mr. Harry Friedberg, of Kansas City, Kas.; "Trials and Tribulations of a New Man," by Mr. Atwood Cady, of Fredonia, Kas.; "Why the People Distrust Gas, Water and Electric Light Companies," by Secretary Sterrett. In addition to these the Association is booked to hear a lecture on the subject of "Some Recent Discoveries in Electricity," by Prof. Lucien I. Blake, of the University of Kansas. The lecture is to be given in the evening, and the Association has invited the Commercial Club, of Newton, to listen thereto as its guests. The Entertainment Committee has arranged for a carriage drive to the pumping station of the local water works, for a visit to the shops of the Santa Fe Railroad system, and for an inspection of the plants of the Gas and Electric Company, of Newton. As said before, President Seabury, Secretary Sterrett and the local committee will have about all they can oversee and direct in carrying out this interesting and varied programme in the time specified.

A POINT WELL TAKEN.—"R.," writing to the JOURNAL under date of Nov. 1st—and it is only one of eight communications related to the subject that we have received since the New York meeting of the American Gas Light Association—very pertinently says: "I doubt very much the wisdom of bandying quotations from foreign gas engineers, for or against this or that subject of argument, which was so conspicuous a feature of one of the discussions[1] upon the floor of our last convention; and it is safe to incline to the opinion that it will not be highly relished by the foreign engineers so quoted. It was clearly shown in the debate referred to that at least one foreign engineer had talked on both sides of the question, and, from the citations given, without qualification, it would be only natural to question the integrity of some one of the parties involved; yet in all probability, if the circumstances were thoroughly put forth, the apparent discrepancy would entirely disappear. Unfortunately, however, as the case stands, the only possible inference was that

1. Our correspondent refers to the discussion on the paper by Mr. R. B. Brown, of Milwaukee, Wis., the title of which was, "Why Milwaukee Did Not Build Inclines."

somewhere or somehow the statements cited lacked the element of veracity. In the majority of cases, our friends across the water give freely of their experience to visiting engineers, but as that was necessarily more or less of a confidential nature, it seems very much like an abuse of privilege to fling such information into a public debate, thus causing the original giver of it to become a target for friend or foe alike, when it certainly must be patent to the quoter that the one quoted had no possible means of defending himself."

NOTES.—

IN our current "Item Columns" mention is made of the sale of certain gas plants in Ohio to those in control of the natural gas interests in the districts mentioned. Since that item was written we have received the following precise information respecting the transactions from a capitalist concerned in the same: "On the 1st inst. the artificial gas plants at Marion and Bellevue, O., and the gas and electric light plants at Fremont, O., were sold to the Union Natural Gas Corporation. As the owners of the latter are the parties who are piping natural gas from the West Virginia field to towns in Northern and Eastern Ohio, and who were seeking franchises in the towns of Bellevue, Marion and Fremont, the owners of the existing plants in the towns named thought it advisable to sell at a good figure rather than to engage in a contest."

THE project for the establishment of a gas plant at Great Falls, Montana, is assuming tangible shape. The people mainly concerned in the enterprise are connected with the Nelson Coal Company, and the names of the organizers of the Gas Company are: John G. Nelson and Samuel McClure, of Stillwater, Minn., and Oscar Nelson, of Great Falls.

THE digest of a recent opinion handed down in a test case in Michigan is as follows: "The failure of a gas company, on introducing gas into a dwelling, to inspect pipes therein which have long been out of use, but which were placed therein by the owner, and over which the company has no control, is not negligence, in the absence of any showing of a duty in such respect from contract, custom or charter."

MR. FRED. E. PERSONS, of Toledo, O., has been elected a Director in the Northern Ohio Natural Gas and Pipe Line Company.

A CORRESPONDENT in Sacramento, Cal., forwards the following: "Mr. George Thompson, bookkeeper for the municipal electric lighting department of Alameda, Cal., has compiled a report of the business done for the quarter ended September 30th last. This is the story of the first 3 months' experience with the new system of keeping the accounts whereby the city charges itself for the light that it uses. On this basis the plant shows a net profit for the period stated of $205.32. The figures are: Earnings, $7,473.45; expenses, $7,268.13; collections from consumers, $2,019.70; collections from other sources, $40.50. The actual income of the plant, estimating the feature of the city charging itself with the light it uses, is represented by the cash collections. On that basis the actual loss for the quarter considered was $5,248.43. No matter how one regards it, the municipal control of the electric lighting supply of Alameda has all the signs of failure."

THE bid of Mr. C. S. Young, of Bakersfield, Cal., for the establishing of a gas works at Hanford, Cal., has been accepted.

Solders for Tin, Cast Iron and Copper.

The *Journal of Gas Lighting* notes that in a recent issue of the "Chronique Industrielle," M. D'Arlatan gives the following method of soldering tin and cast iron: Clean the iron carefully, so as to remove all traces of oxidation, saturate it with spirit of salt containing a little zinc, heat the iron until the tin will melt by contact, and then solder to the tin in the usual way. For soldering copper, he recommended as follows: Take a solution of chloride of zinc and moisten the parts to be soldered, after they have been well cleaned; then bring them together, and place them in their final position. Heat up with the blowpipe, and let the solution evaporate. Bring the tin near, and when sufficiently hot it will melt, and run between the surfaces, which it will solder perfectly. A thin layer of lead amalgam should be placed between the surfaces, and an ordinary soldering iron passed rapidly along the joint. The heat disengages the mercury from the amalgam, and the lead melts and solders the two surfaces. A cement made as follows is given as a cold solder for iron. Six parts each of sulphur and white lead to one part of borax. Dilute in concentrated sulphuric acid, and apply; press the parts well together, and allow the joint to rest for five to seven days.

[LIMITED ABSTRACT.—Continued from Page 626.]

PROCEEDINGS, THIRTIETH ANNUAL MEETING AMERICAN GAS LIGHT ASSOCIATION.

HELD IN THE GREEN ROOM, NEW YORK ATHLETIC CLUB, NEW YORK CITY, OCTOBER 15TH to 17TH, 1902.

FIRST DAY—WEDNESDAY, OCTOBER 15.—MORNING SESSION.

REPORT OF COMMITTEE ON A UNIFORM SYSTEM OF ACCOUNTS FOR GAS COMPANIES.

Mr. A. C. Humphreys, Chairman of the Committee on a Uniform System of Accounts for Gas Companies, read the following report:

To the American Gas Light Association: Your Committee on a Uniform System of Accounts for Gas Companies herewith submits revised classification sheets, journal entries and explanations, as called for by its preliminary report rendered to the Association at the meeting last October, and the further report of January, 1902, mailed to each member of the Association.

At the meeting of last October your committee was charged with the duty of perfecting its report, and to then submit the result of its labors to the members individually by mail, with the understanding that the members should individually study the report and mail to the committee their criticisms and suggestions by April 1, 1902. The committee considered it advisable to extend the time for the receipt of such criticisms and suggestions to May 1st.

The committee regrets to have to report that, although it carried out its part of the work, the membership in general has rendered but little assistance. Mr. George McLean, of Dubuque, Ia., made some valuable criticisms and suggestions in one special line. Mr. H. L. Rice, of Norfolk, Va., considered the report in detail and made valuable suggestions. Outside of these gentlemen the work of criticism has been confined to the officials of the United Gas Improvement Company, and special reference should be made to the very complete joint criticism submitted by Messrs. William J. Serrill and Walton Forstall, of that Company. It is also proper that the committee should make special mention of the services rendered by Mr. E. L. Brundrett, General Auditor, Mr. Walter R. Elliott, formerly Assistant General Auditor, and Mr. G. W. Curran, now Assistant General Auditor, of that Company.

It is probably unnecessary for your committee to explain at length the difficulties it has encountered in its efforts to develop a uniform system of accounts for gas companies which could be reasonably recommended for general adoption. If the membership at large had complied with the committee's request (and the committee feels it had a right to look for such compliance), its work would have been lightened and simplified, and the chances of a final completely satisfactory result greatly increased.

Your committee feels that the line of procedure adopted by it should have resulted in the development of a system which, through the full co-operation of the membership in the way of criticism and suggestion, would have recommended itself to the members of the Association for general adoption, and so have made the system, in fact as well as in name, a uniform system of accounts. Your committee fully appreciates that such a system must be open to individual criticism, and that only by a full and general discussion can the differing opinions be brought into line and the membership as a whole be prepared to adopt any one system, no matter how perfect it may be.

The committee fears that if it finally recommends a system, after having induced only about 1 per cent. of the membership to interest itself in the duty of suggestion and criticism, many of the members may be then ready to furnish reasons why the result of the committee's work does not commend itself to them for their adoption. Unless the system is generally adopted, the result originally desired, and for which the committee has conscientiously labored, will not be obtained. If, then, this system of accounts, for the reasons given, fails of general adoption by the companies represented in this Association, upon the membership at large must rest the responsibility.

Your committee has spent as much time as possible, since the receipt of the criticisms, endeavoring to perfect the classification sheets for presentation at this meeting. Many of the criticisms referred to above have been adopted, and this involved many changes in the system, and these changes in turn either suggested or made necessary others. Most of the criticisms and suggestions made had reference to the distribution accounts and, therefore, the changes are in greater part to be found in that department. As far as the other accounts are concerned, they are practically the same as last presented, nothing having occurred to change the opinion of the committee as to any essential point.

Your committee now feels that, as far as it can go, it has completed a uniform system of accounts which is worthy of general adoption. Your committee also believes that any further appeal for criticisms or suggestions through the mail would fail to bring results; but, if the discussion of this report should demonstrate that the committee is mistaken in this belief, then it will be prepared to consider such further criticisms and suggestions received through the mail by the committee not later than the 15th of November, 1902.

Your committee now recommends that the Association approve the system herewith submitted, and adopt it as a standard for the American Gas Light Association, and the committee be empowered to make such changes or additions to the classification sheets as may be found desirable by reason of any further criticisms received up to November 15th, 1902, and to complete such forms and blanks as will, in its opinion, facilitate the most efficient use of the system; the completed report, including blanks, to be then printed and a complete set mailed to each member by the Secretary of the Association.

Your committee, in preparing a junior system of accounts, has been influenced so to do by the expressed demand for a simpler system; for your committee, in submitting a condensed system in accordance with this demand, would call attention to the fact that, while a condensation of accounts lessens the actual labor in the bookkeeping department, it distinctly adds to the labors of the conscientious manager, as it affords him less opportunity to effectively analyze his operating costs and make the proper comparisons, and such comparisons can then be completely made only by laboriously subdividing these condensed book accounts at greater cost, as the occasion demands.

Respectfully, ALEX. C. HUMPHREYS, A. P. LATHROP, LEWIS LILLIE, } Committee.

The "Junior System of Accounts," as submitted by the committee, is as follows:

The following classification of accounts is intended to embrace the same general accounts as the senior system, and, although a number of the sub-accounts are merged into one account, in order to reduce the volume of accounts for the smaller companies, the identity of the general accounts is maintained.

The items making up the various sub-accounts will be found in the senior classification book, the intention being to have both the junior and senior systems conform; and any company adopting the junior system is referred to the senior classification book for details of accounts and rules for closing.

A.—*Manufacturing Account.*—Where coal gas and water are both made, the following sub-accounts will be closed at end of fiscal year into the proper account—"Manufacturing Coal Gas," or "Manufacturing Water Gas," as the case may be:

1. Boiler fuel.
2. Expense, works.
3. Enricher, coal gas.
4. Fuel under retorts.
5. Generator fuel.
6. Gas coal.
7. Manufacturing labor.
8. Oil (water gas.)
9. Purification, to take place of and include:
   9. Purification labor.
   10. Purification supplies.
11. Repairs works, to take place of and include:
   11. Repairs works, general.
   12. Repairs works, coal gas, } Proportion monthly between coal
   13. Repairs works, water gas, } and water gas, based upon volume of each kind of gas made.
14. Water tax.
15. Residuals, to take place of and include:
   15. Ammoniacal liquor expense.
   16. Coke expense.
   17. Tar expense.

B.—*Distribution Account.*—This is the general account into which the following sub-accounts will be closed at end of fiscal year:

1. Distribution expense, to take place of and include:
   1. Distribution, office expense.
   2. Setting and removing meters.
   3. Complaint expense.
   4. Gratuitous work.
5. Repairs mains and services, to take place of and include:
   5. Repairs mains.
   6. Repairs services.
   8. Street mains abandoned.
7. Repairs meters.

C.—*Commercial Expense.*—This is the general account into which the following sub-account will be closed at end of fiscal year:

2. Expense office, to take place of and include:
   1. Expense, collection.
   2. Expense, office.
   3. Office salaries.

D.—*Expense Account.*—This is the general account into which the following sub-accounts will be closed at end of fiscal year:

1. Accidents and damages.
2. Expense general, to take place of and include:
   2. Expense general.
   3. Expense extraordinary.
   6. Litigation.
   7. Association meetings.
4. Insurance.
5. Interest.
8. Salaries general.

E.—*New Business Account.*—This is the general account into which the following sub-account will be closed at end of fiscal year:

1. New business expense, to take place of and include:
   1. Advertising.
   2. Appliance demonstrations.
   3. Expense soliciting.
   4. Gas appliances.
   5. Gas engine expense.
   6. House fitting expense.

F.—*Discount.*—This account is intended to show the amount of discount allowed consumers for prompt payment of gas bills; also, any special discounts allowed in the adjustment of consumers' accounts.

G.—*Taxes.*—This account is intended to show the amount of taxes, whether paid, due or not paid, or accrued but not due, applicable to the elapsed period of the current fiscal year.

H.—*Street Lamp Operating.*—This account is intended to show the cost of all labor and material employed in operating and repairing street lamps.

Profit and Loss Year 190..—This is the general account into which the following accounts will be closed at end of fiscal year:

Dividends.
Interest on bonds.
Interest on borrowed capital.
Gas.
House and land rental.

Inventory Account.—This is a general account intended to take the place of and include the following accounts:

Ammoniacal liquor.
Coke.
Tar.
Store room.
Stable.

Manufacturing Supplies Account.—This is a general account intended to take the place of and include the following accounts:

Boiler fuel stock.
Generator fuel stock.
Gas coal stock.
Fuel under retorts stock.
Enricher coal gas stock.
Oil (water gas stock).

Accounts Receivable.—Accounts receivable are carried in the following open accounts—in a statement of assets and liabilities they may be grouped under a general heading as above, "Accounts receivable." [For details, see senior classification.]

Gas sales.
Sundry sales.
City of.....
Bills receivable.

Accounts Payable.—Accounts payable are carried in the following open accounts—in a statement of assets and liabilities they may be grouped under a general heading as above, "Accounts Payable." [For details, see senior classification.]

Deposits.
Accounts payable.
Bills payable.

Advance Payment Accounts.—Advance payment accounts are carried in the following open accounts—in a statement of assets and liabilities, they may be grouped under a general heading, as above, "Advance Payment Accounts." [For details see senior classification.]

Advance Taxes.
Advance Insurance.

Accrued Accounts Not Due.—Accrued accounts not due are carried in the following open accounts—in a statement of assets and liabilities, they may be grouped under a general heading, as above, "Accrued Accounts Not Due." [For details see senior classification.]

Accrued Taxes.
Accrued Interest.
Accrued Interest on Bonds.

General Accounts.—General accounts are carried in the following open accounts—in statement of assets and liabilities, they may be grouped under a general heading, as above, "General Accounts." [For details see senior classification.]

Prepayment sales.
Uncollectible bills.
Sales suspense.
Profit and loss.
Expense stable.
Expense storeroom.
Plant, franchise, etc.
Cash.
Capital stock.
Bonds payable.
Merchandise.

Betterment Accounts.—Betterment accounts are carried in the following open accounts—in a statement of assets and liabilities, they may be grouped under a general heading, as above, "Betterment Accounts." [For details see senior classification.]

Extension of street mains.
Extension and improvement.
Street mains.....
New meters.
New services.
Street lamp extension.
Real estate.
Street main improvement.

Discussion.

Mr. Humphreys stated that the report was too long to permit its being read and discussed at length at a meeting of the Association, but requested members to examine it at their leisure and to send any suggestions which might be of value to the committee. The committee had prepared and submitted a junior and also a senior system of accounting. The clastification of accounts presented by the junior system was intended to embrace the same general accounts as the senior system, but to reduce the volume of accounts for the smaller companies; although a number of sub-accounts were merged into one account, the identity of the general accounts had been maintained. Any company adopting the junior system was referred to the senior classification sheets for details of accounts and rules of closing. The committee did not purpose making the junior classification sheets complete, but to prepare complete senior classification sheets, with necessary memoranda, thus enabling one to obtain from those sheets and the skeleton description of the junior classification system a complete understanding of both the junior and the senior systems.

Mr. A. S. Miller considered the work of this committee the greatest which had been done since the educational system was started, and said that the Association should be more than grateful to those who had given so much time and labor to the preparation of this report. He moved a vote of thanks, and that the report be printed and circulated in such form as the committee may recommend.

Mr. Egner said that he had begun the study of this report in rather an antagonistic and caviling spirit, but the more he had studied it the better he liked it. The system was not as complicated as it seemed, and he was prepared to heartily recommend its adoption.

Mr. Doty inquired why the committee had credited residuals to the manufacturing account. He believed the general practice obtaining both in this country and in England was to credit the earnings from residuals to the gross earnings of a gas company. The Massachusetts Board of Gas and Electric Light Commissioners had established that practice in that State; and in Ohio the law required that residuals should be accredited to earnings, and as such pay an income tax.

Mr. A. E. Forstall thought Mr. Doty was under a misapprehension as to the English custom. He had carefully gone over the published analyses of the English companies, and had observed that the deduction for residuals was made, not from the cost of manufacture, but from the gross cost to the company of the gas delivered. All the items of cost were given and the total made up, then, before giving the income, residuals were credited, and the final item on the cost side was the net cost of the gas as arrived at with the residuals deducted. There was a more important reason for doing that in this country than there was in England, for the reason that it was very important for the manager of a gas company to be able to determine which cost him most - coal or water gas. If his accounts are so kept that he can see at a glance the relative cost of the coal and water gas in the holder, then residuals must be deducted directly from the cost of manufacture. His preference had always been to deduct the residuals directly from the cost of coal, so that all the items of cost could be compared as between the two gases.

Mr. Littlehales agreed with Mr. Forstall's statement as to the English custom, and did not see how it was possible to ascertain the relative cost of coal and water gas from any statement which did not credit residuals in favor of the coal gas.

Mr. Egner inquired why the heading, "Profit and Loss," could not be eliminated from the proposed system of accounts, for he thought it had no place there.

Mr Humphreys believed it was the general practice to account for residuals just as the committee had done. The first thing to be determined was the cost of gas in the holder, and the items incidental to that part of the business should be isolated from the other items of final cost. It was eminently logical to first determine the net holder cost. They were not in business to manufacture tar, ammonia or coke but to manufacture gas; incidentally, certain by-products were made and the residual rebates should be deducted before the cost of gas in the holder was stated or the cost of distribution considered. This treatment was logical, and it had the backing of precedent. Replying to the suggestion as to eliminating the title of "Profit and Loss" from the system, Mr. Humphreys said he could not at the moment see any objection to continuing the old practice in that regard. He did not think it well to make a change merely for the sake of change. A different title, more in accord with the facts, might be adopted, but there must be some final account in which to group profits and losses.

The recommendation of the committee as to the report was then adopted.

Report of Committee on Research.

Mr. A. S. Miller presented the following verbal report of the Committee on Research:

During the past year your committee went further into the subject of standards and have made up more or less complete drawings showing details of the standards. They have carried the standards on a step further, and have made each portion of the street main specials standard; that is, taking a standard flange, with a certain amount of pipe behind it, they fitted that to every other special and to every form of special, whether a bend, a T, a cross, or any other form. The patterns for quarter bends can be divided into halves for one-eighth bends, and can be divided for one-sixteenth bends, so that a minimum number of patterns will be necessary to make all the specials. I have passed down two prints embodying these suggestions. Some time within the next few months we hope to distribute drawings among members of the Association for their approval and criticism, and for such amendments as may be suggested by the members. We will present them at the next meeting for final approval. In this connection I am pleased to report that we have arranged matters so that most of the details will be called for by the largest companies in the East; and I now think that we have behind us sufficient pressure to compel all the foundries to carry these as standards. I think in the future, after a year or two, it will be as difficult to get anything different from these as it is now difficult to get the special standards.

Very little other work has been done by the committee, with the exception of using pressure to get certain papers more or less along the line of original investigation, and we have secured at least three of these.

The report of the committee was received and placed on file.

Committee on Place of Next Meeting.

The President appointed as the Committee on Place of Next Meeting Messrs. E. G. Pratt, A. H. Strecker and C. R. Faben.

A Brace of Invitations.

The Secretary read an invitation from the Rapid Transit Subway Company, to visit the completed portion of the tunnel at the West Fifty

ninth street station ; also an invitation from the Interurban Street Railroad Company to visit the power house at First avenue and Ninety-sixth street. The invitations were accepted with thanks.

Mr. I. N. Knapp, of Philadelphia, Pa., then read the following paper on

SOME NOTES ON CEMENT MASONRY.

Mr. President and Gentlemen of the American Gas Light Association: Members of your Council requested me to prepare a paper on cement masonry for this meeting. Its importance is shown by the increased use of hydraulic cements, as shown by statistics of their manufacture and importation. I, therefore, venture to present to you a few notes on this subject.

The following statement of the production of cement is from the "Mineral Resources of the United States," for 1901:

Year.	Total Production of Portland Cement in the United States, in Barrels.	Portland Cement Imported into the United States, in Barrels.	Natural Cement Produced in the United States, in Barrels.	Slag Cement Made in the United States, in Barrels.
1891 ..	454,813	3,443,126	7,767,979	....
1899 ..	5,652,266	2,108,388	9,868,179	....
1900 ..	8,842,020	2,386,683	8,383,519	365,611
1901 ..	12,711,225	922,426	7,084,823	272,689

From these figures it appears that in the United States in the last 10 years the manufacture of Portland cement has increased 28-fold, and its importation has materially decreased; also, the manufacture of natural cements has about held its own, and the manufacture of slag cement has been commenced.

The total consumption of all kinds of cement in the United States for 1901 the same authority gives as 20,573,538 barrels.

If we should load 100 barrels to a car, and these cars took on an average 38 feet of track room, they would fill a siding about 1,480 miles in length, if all were loaded at one time. If such siding paralleled the usual routes of travel, it would reach from New York to Omaha via Chicago, or a little beyond, according to the route traveled.

We find in the general market the hydraulic cement with which to make our cement masonry classified according to the method of manufacture under three general heads: Portland cement, natural cements and slag cements.

The term Portland cement is commonly used to designate an artificial mixture of finely ground carbonate of lime and siliceous clay in proper proportions, calcined to a clinker at a temperature of incipient fusion and again finely ground.

The natural cements are those produced wholly from a natural rock. These rocks are a carbonate and magnesia limestone containing from 20 per cent. to 40 per cent. of clay, calcined to a clinker just short of fusion and finely ground.

The slag cements are made from a mixture of ground blast furnace slag and slaked lime in proper proportions without further calcination.

The character of Portland cement has greatly improved in the last 10 years, as a result of the systematic testing of the raw material and finished product under scientific supervision, and its manufacture has about reached practical perfection. In natural cements, where careful attention is given in selecting rock from the proper strata, a uniform product may be had quite sufficient in strength for nearly all kinds of engineering work. The slag cements are not on the market very extensively, and my personal experience with them has been slight.

I cannot go fully into the question of testing hydraulic cements in the limits of this paper—it is an arbitrary matter, and chiefly valuable as a means of comparison—but will point to a few facts brought prominently out by my own experience. What it is necessary to know about any cement we propose to use is that it will set and harden into a solid mass sufficiently strong for our purpose when properly mixed with sand and water, and make a mortar for brick, stone or concrete that will firmly adhere to any surface with which it may be in contact, and that it will endure without change of form or loss of strength for a long time. For these properties the gas superintendent or manager had better depend upon the reliability of an established brand of cement, with occasional samples sent to a testing laboratory, rather than to rely on his own tests, unless he has time to learn the business of testing cements, or his construction work is extensive enough to justify having an assistant for such work. We are certainly pretty safe in accepting for gasholder tanks, engine foundations and other important work a brand of cement which has been in actual use in such class of structures for a period of years and given satisfaction.

I will say frankly that when I first began testing cements I met with some mortifying experiences in rejecting cement which, when properly mixed, would make briquettes that would fully meet the tensile strength required by the specifications. I must also confess that before I had actual experience in testing cement, and in putting in cement masonry, I had an idea that no special experience or skill was necessary for the successful manipulation and use of hydraulic cement. The facts are, it is really skillful work to develop the best strength of a given cement, just as much as it is skillful work to weld iron and get a perfect weld. The Committee on Standard Tests of the American Society of Civil Engineers, in their report, call attention to this matter in the following words:

"The testing of cement is not so simple a process as it is sometimes thought to be. No small degree of experience is necessary before one can manipulate the material so as to obtain even approximately accurate results. The first tests of inexperienced, though intelligent and careful persons, are usually very contradictory and inaccurate, and no amount of experience can eliminate the variations introduced by the personal equation of the most conscientious observers. Many things, apparently of minor importance, exert such a marked influence upon the results that it is only by the greatest care in every particular, aided by experience and intelligence, that trustworthy tests can be made."

An investigation, by Prof. J. M. Porter, of Lafayette College, is interesting in this connection. He divided a sample of Portland cement into 9 parts, sending each to a different laboratory with the request that tests be made of it in 1 C. to 3 S. mortar, according to the rules recommended by the committee of the American Society of Civil Engineers. The resulting average strength reported from each of the 9 samples sent for tests was as follows: 75, 102, 114, 136, 153, 163, 176, 225 and 247 pounds. Average of all, 153 pounds, and the lowest strength was but 30 per cent. of the highest.

The report from the laboratories is shown in detail in Table A.[1] If the results of tests for tensile strength got by experienced men in permanent laboratories vary so much with the same identical cement, what is to be expected of tests made by men with little or no experience?

The proper manipulation of cement in making tests of its quality is really an art. The result of tests of cement by experts for fineness and for tensile strength, either neat or with different proportions of sand, are of great practical value in guiding us in the way to use cement to secure the best results in our cement masonry. The test for fineness simply is sifting the cement through a sieve, or a set of sieves, and observing the amount retained by each sieve. It is necessary to have sieves with approximately perfect regularity of spacing and diameter of wire. The diameter of the wire should be about one-third of the spacing between centers. It has been found by experiment that only the finest or most impalpable dust is really active in the setting and hardening of the cement. I know by my own experiments that the particles of cement that will pass a No. 50 sieve, and hold on a No. 70 sieve, have no cementing property whatever. The fineness that should be required is largely a matter of relative economy—the finer the cement the larger the quantity of sand that may legitimately be used with it. On the other hand, if the requirements for fineness compel the manufacturer to do an unusual amount of grinding, he must add to the price.

The leading manufacturers can readily comply with a specification that will require that not more than 1 per cent. of a Portland cement shall remain on a No. 50 sieve, and not more than 10 per cent. on a No. 100 sieve; and for a natural cement not more than 5 per cent. shall remain on a No. 50 sieve, and not more than 20 per cent. on a No. 100 sieve.

At this point I will make two quotations on the chemical and physical changes involved in the setting and hardening of cement. Prof. S. B. Newberry says—See "Mineral Resources of the United States for 1891; page 537: 'A very interesting series of experiments on the active constituents of cement and the cause of hardening have been published by Le Chatelier; 'Annales des Mines,' 1887; 388, 413, 465. Full abstracts of these papers will be found in the *Journal of the Society of Chemical Industry;* 1888; 567, 847. Tricalcium silicate, $3CaO, SiO_2$, or Ca_3SiO_5, hardens to a stonelike mass in water and is the chief active constituent in all classes of cements. This silicate is very infusible, and cannot be obtained by the direct combination of silica and lime, but only by the agency of some fusible silicate such as clay. Microscopic examination of good cement clinker shows the presence of quantities of colorless, doubly-refractory crystals resembling sections of cubes. These consist of the above mentioned tricalcium silicate. The interstices between these crystals are filled with reddish or greenish brown substances, which are probably silicates of lime, alumina and iron. After hardening in water, cement shows the presence of numerous hexagonal plates, consisting of calcium hydroxide, mixed with a translu-

1. For tables and figures see end of paper.

cent white mass composed of interlaced groups of slender crystals of hydrated calcium silicate, $CaSiO_3$, 2.5 H_2O."

Prof. J. B. Johnson, C.E., on the same subject says—see "The Materials of Construction," page 189: "By the *setting* of cement is meant its initial change from a soft or plastic mortar to a friable solid. This change is usually effected with great suddenness after it begins, as shown by the curves in Fig. 1, and it has been shown to be always accompanied by the evolution of heat. After the cement has become thoroughly set it is still very weak, and is readily pulverized in the fingers. If left undisturbed, however, it increases in hardness and strength, sometimes for several months, but generally for many years. The setting of cement is thought to be effected by the crystallizing out of the silicate and the aluminate of lime, which are soluble in water in their anhydrous form. After dissolving in the water they pass to the hydrated state in which they are insoluble, and hence are precipitated in a crystalline form with a development of heat. This process is greatly hastened at higher temperatures.

"The *hardening* of cement is due to a continued crystallization of salts from solution, and to further chemical and physical changes which develop slowly, but which continue for long periods of time. There are so many kinds of combinations of various substances which will serve to produce the final characteristics of hardened Portland cement, that there must be many different chemical compounds which, after calcining, will harden on the addition of water. The problem is so complicated that it has as yet defied a complete chemical analysis."

Theoretically, a mixture containing 16.6 per cent. silica and 83.4 per cent. carbonate of lime, heated to a temperature such that all the silica and lime would combine and then finely ground, would form a Portland cement showing maximum hardening properties.

Referring again to the fineness of cement. In Fig. 2 is shown graphically the tensile strength in pounds per square inch of unsifted cement, both neat and when mixed with sand, compared with the same cement sifted. In 6 months the unsifted cement gave about 280 pounds and the sifted cement gave about 390 pounds, both mixed 1 C. to 3 S. In the same time the unsifted neat cement gave over 700 pounds and the sifted about 500 pounds.

From this it appears the sifted cement developed about 40 per cent. more strength than the unsifted, with 1 C. to 3 S., while the unsifted cement gave about 45 per cent. better results neat than the sifted. This indicates that a test of cement mixed with sand is a better index of a cement's value for use in cement masonry than a neat test. It is rather surprising that the unsifted neat cement should show 45 per cent. greater tensile strength than the sifted neat cement.

I would offer as an explanation of this difference that the neat sifted cement practically all became hydrated, and in setting and hardening formed slender crystals of a regular order, which we might liken to straight-grained wood, and that in the unsifted cement the coarse particles are inert, but they cause the slender crystals formed by the finer particles of cement that become hydrated to deflect and interlace in the process of setting and hardening, which we might liken to gnarled or cross-grained wood which would offer greater resistance to splitting or tearing apart than straight-grained wood.

For tests of tensile strength the form of briquettes recommended by the committee of the American Society of Civil Engineers is the one in common use. I cannot go into the details of making briquettes, but will give some results which are valuable guides in indicating the way to get the best results from cement used in cement masonry. It has been found impracticable in making tests to specify any particular percentage of water for all kinds of cement, or even for all brands of one class, as of Portland cement, or of natural cement. The effect of using varying quantities of water with neat Portland cement I show in Tables B and C; with neat natural cement in Table D. The tables are shown graphically in Figs. 3, 4 and 5. Figs. 6 and 7 also relate to the effect of using varying amounts of water with Portland and natural cement through a larger range than my experiments.

The experiments show that the quantity of water used very materially affects the tensile strength of mortar, and that when an excess of water is used it is weakening in effect and the strength of the cement develops very slowly This is of value to show us to avoid excess of water in our cement masonry. It is a common error to suppose because cement will harden in water that it cannot be harmed by using an excess of water. I have prepared some rough experiments to illustrate the effect of water on cement, and they are here for your inspection.

On July 13th I put 1½ pounds of water in a Mason jar and then put in one pound of Portland cement. The jar was thoroughly shaken then, and once an hour thereafter for 6 hours during that day. It was shaken up morning and evening every day for 10 days and occasionally thereafter. From former experiments of this kind I know this cement will be nothing but mud. There can be no question but that the chemical reactions due to hydration have taken place, and the cement has really set, but the particles of cement being kept apart by the excess of water and manipulation have failed to unite in crystals and harden. At the same time, I put 1½ pounds of water in the same kind of jar, poured in a pound of Portland cement and let the jar stand quietly. I know we will find a marked separation in the cement, and that the bottom will be darker colored and look coarser than the top. There will be a hardening of the cement, but it will not be brittle like cement that is allowed to set in air and then harden in water.

I also made a mortar with a pound of Portland cement, using just water enough so that when the cement was tamped into a jar the water would show on the surface of the cement. I know you will find a mass of cement that is hard, brittle and stonelike. I have put some cement in lamp chimneys. You will find that neat cement mixed as grout shrinks considerably; that neat cement mixed to a soft mortar cannot be thoroughly compacted on account of the formation of air bubbles; that cement just damp enough to pack when squeezed in the hand will fill a lamp chimney more solidly, will not shrink, and will set and expand in hardening and crack the chimney.

Of course, in making cement mortar we have to have the mortar plastic, and the sand prevents the formation of air bubbles to the extent they form in the neat cement of the same plasticity. It is a mistaken idea that an excess of water by grouting gives solid cement masonry, for the contrary is true. In a dry, hot summer day it is necessary to use an amount of water that would be too much in cold, damp weather, and which amount would ruin the work by freezing out in winter weather. The quantity of water to use in putting in cement masonry is a matter of experience and good judgment, but the tendency is to use water in excess, and I shall mention this matter further along in these notes.

In Table E, I show the quantity, by weight, of a good quality of bank sand that would pass sieves of different mesh; also the effect of sifting the sand and mixing with a natural cement, 1 C. to 1 S. It is worthy of note that in 60 days all the sand and cement mixtures of my experiment were stronger than the neat cement, as is shown graphically in Fig. 8. I also know by experiment it is true of Portland cements that a 1 C. to 1 S. mixture with selected sands makes stronger briquettes than neat cement. Fig. 9 shows further experiment with sand of different degrees of fineness with cement. From this we must conclude very fine sand is to be avoided, that it is well to get as coarse a sand as the work will admit of, and that with concrete we may use with the sand fine gravel to advantage. If we wish to develop the highest strength of our hydraulic cement in the shortest time, we must get a clean, coarse sand, and it is better to pay a good price, $1 to $1.50 per yard, than to use a poor grade of sand that cost nothing. Some very serious failures have occurred by the contractors taking sandy material from the excavation made for foundations and using the same in making cement mortar, the buildings collapsing by the failure of the cement masonry of the foundation walls.

Fig. 10 shows the weakening effect produced by regauging neat Portland cement on the strength of the cement as tested after hardening for 6 months in water. This shows the necessity of mixing and using cement mortar without any retempering on account of set, if we expect to get uniformly good results with our cement. It is reasonable to expect that retempering cement mortar after the set has commenced should materially weaken the mortar, because the strength of a hardened cement is due to the precipitation in crystalline form of its active cementing constituents. It is a well known fact that many salts precipitate from their saturated solutions in crystalline form, and that after the formation of crystals has commenced in such solution any agitation of the solution alters the form of crystallization very materially, and usually the secondary formations do not take place as rapidly, are smaller in size, and the deposit is not so dense. To use another illustration, though not strictly analogous, we see in the freezing of still water the formation of needle-like crystals that knit together into clear, strong ice, but if the water is agitated we do not get the long crystals nor the strongest ice.

Referring again to Fig. 1 we have shown graphically the effect of temperature upon the time required for the beginning and ending of the set in a Portland cement. At 40° F. the quality of cement under test commenced to set in 9 hours and was complete in 20 hours. As the temperature increases the time of setting decreases, until, at about 120° F., the setting begins immediately and is complete in 3 hours. Prof. Spaulding states ("Hydraulic Cement," page 64) that in some cements between 100° and 140° F. a change is suddenly made from a very rapid to a very slow rate of set, which then gradually decreases as the tem-

perature increases, until practically the cement mortar will not set at all. The data given in Fig. 1 show us the importance of considering the temperature at which our cement masonry is being constructed. It is evident in very hot weather our cement mortar has to be used in the work sooner than in cool weather in order to avoid weakening it by re-tempering.

My experience is that holder tank work and engine foundations can be successfully put in during freezing weather if a brick is used that will absorb the excess of water from the mortar quickly. I found it a mistake to use hot water in making the cement mortar or to make the sand and brick hot. The cement mortar should be about 40° to 50° F., and the brick can be some colder, provided they are dry from the kiln and are not so cold but they will dry up the water at once; the fresh work can then freeze and thaw, and when it does thaw out it will do so slowly. When there is not enough sensible moisture to produce expansion by freezing there can be no damage.

The adhesive strength of cement mortars is their ability to firmly adhere to any surface with which they may be placed in contact. Tests of adhesive strength as a measure of the quality of cement mortars are not made because of the difficulty of getting reliable results.

Prof. Johnson says ("Materials of Construction;" page 601): "The adhesive force of ordinary cement mortar to brick surfaces is very small. A strength of 25 pounds per square inch seems to be about all that can be ordinarily counted on. This low adhesive strength may be partly due to the fact that the bricks are covered with a coating of disturbed and loose particles."

It is my observation that bricks that are sanded in moulding have a coating of loose particles, and cement mortar does not adhere to such brick, but that to good, hard or vitrified brick there is good adhesion.

A test for adhesive strength, by cementing 2 bricks or 2 stone surfaces together and pulling them apart after a certain period of time, can hardly be taken as indicative of the working adhesive strength of cement mortars. In actual condition the weight of the overlying work must bring the particles of mortar in closer contact in itself and to the surfaces presented, and the hardening of the cement must produce better adhesion; and also, the tensile strength is, no doubt, stronger than the ordinary briquette hardened in water. I have never made or heard of any such tests being made to cover these points, but from cutting into good work I feel confident it is a fact.

Prof. Johnson says ("Materials of Construction;" page 602): "The ultimate adhesive strength of good Portland cement with limestone screenings, 1C. to 2S., to plain iron or steel bolts, may be taken at about 1,000 pounds per square inch."

From this data it is recommended that, to provide a sufficient factor of safety in setting anchor bolts, a depth of 30 to 40 diameters be used. I have used neat Portland cement made into a grout for setting bolts. If a cement mortar is made thin enough to fill a bolt hole, the tendency is for any sand or screenings mixed with it to settle. Sometimes in setting a new engine or machine on an old foundation, or in new work where a bolt is left out or a portion of a template reversed, foundation bolts may be satisfactorily put in by drilling a hole but little larger than the bolt, hanging the bolt in the hole in its exact position, and then pouring in a neat Portland cement grout filling. Make the grout by taking a bucket of water a little over half full, stir in the cement until the grout is as thick as can be stirred and then pour into the bolt hole. The bolt may be enlarged a little at the bottom end and should hang perfectly free in the hole, and as soon as the grout is poured the bolt should be raised up and down several times to work out the air bubbles and get good contact between the bolt and grout. The cement will settle in the hole on standing, and must be filled up a couple of times after the first pouring. I have set small engines of 30 to 50-horse power with all the bolts put in in this way, and started up under full load in a week and the bolts held all right.

Cement mortars and concrete are ordinarily subject to compression only, and it would seem as if compression tests should be employed; but it is not usual to make them, for tensile strength has a definite relation established with compression strength (see "Johnson's Materials of Construction;" page 419); also, tensile tests can be more uniformly made and applied and with much lighter apparatus. Generally speaking the compression strength is 8 to 12 times the tensile strength.

There are many other physical tests of cement made besides those mentioned, as well as chemical tests, but they do not throw much light on the practical use of cement in constructing cement masonry.

The practice of adding cement to lime mortar without definite measurement I believe to be bad, because it produces irregular work. I have tried lime paste to make cement lime mortar with indifferent results. The use of cement lime mortar is recommended by the Association of German Portland Cement Manufacturers; and I quote the following from Prof. Newbury's translation of their recommendation (see "How to Use Portland Cement;" page 21):

"There are many kinds of work which require a quick-hardening mortar, but for which the great strength of a mixture of 1 cement with 1 to 4 of sand is unnecessary. The cost of such mortar is also, for many purposes, too high. A mixture of cement with 5 or more parts sand would give abundant strength, but such mortar works too "short" and adheres too imperfectly to the brick or stone; it cannot, therefore, safely be used. In such cases the addition of slaked lime or hydraulic lime will correct the faults of poor mixtures of cement and sand, and will produce a cheap mortar suitable for a great variety of uses. The addition of slaked lime allows the full advantage to be obtained from the use of good Portland cement, and makes it possible for this material to compete in price with cheaper hydraulic materials. Used in this manner Portland cement may be employed with economy for the most ordinary purposes. The advantages of Portland cement lime mortar are its cheapness in comparison with other hydraulic materials, its rapid hardening, marked hydraulic properties, great strength on exposure to air and remarkable resistance to weather.

"The following mixtures for cement lime mortar have been found by experience to be most suitable:

Cement	1	Sand	5	Lime paste	½
"	1	"	6 to 7	"	1
"	1	"	8	"	1½
"	1	"	10	"	2

The above proportions are to be taken by measure.

"Hydraulic lime may be used in place of ordinary slaked lime. Cement lime mortar is prepared by making a dry mixture of the required quantities of cement and sand; milk of lime is then made with the necessary quantities of lime paste and water, and this milk of lime thoroughly mixed and worked in with the mixture of cement and sand. The great advantages of cement lime mortar for a multitude of purposes deserve to be more widely recognized than they are at present."

The gas superintendent or manager should know something of the quality of the sand, stone and brick it is usual to use in constructing cement masonry in his vicinity. If, however, he is going into a new locality to construct a gas works, before writing up his specifications he should look up the materials that are ordinarily used in that locality in cement masonry. He should examine the stonework and brickwork of structures somewhat similar in character to those it is proposed to erect, and learn where these materials came from. It would be well to visit neighboring sandpits, and frequently it will be found that certain streaks in sandpits contain by far the best quality of sand, or a longer haul by teams will get to a better pit, and for a slight advance in price he may be able to get all his sand of the best quality available. It is also well to visit stone quarries in the vicinity and see which has the best quality of stone and facilities for getting out the same. It is also well to visit the brickyards and note their facilities and the quality of their brick in the kiln.

If he has much brickwork to do he can make a very close estimate of the number of brick required for the proposed work, by measuring the length taken by a number of stretchers and headers, and counting the number of courses in a given height in the wall of a building of similar character to that proposed, and in this way he can make a very close estimate of the number of brick required, knowing the amount used in a cubic foot by actual measurement.

In preparing for a foundation of cement masonry it is essential that the excavation be thoroughly drained so the concrete or footing courses of stone may go in dry, and no water rise on the masonry until the cement mortar has thoroughly set. Look out for surface drainage and prepare so that a heavy shower of rain will not flood the excavation and weaken the fresh masonry. If cement masonry is built against rock which has springs flowing from crevices, this water must be taken care of by weepers.

The proportion of cement masonry put in in the form of concrete is larger year by year. I have no definite figures, but cement manufacturers inform me they estimate an increased use of 5,000,000 barrels of cement for 1902 over 1901, and a considerable part of this increase will go into making concrete.

To make good concrete it is necessary that the component parts of broken stone, gravel, sand and water all be clean and free from dust, so there can be good adhesion of the cement to all the surfaces. The stone or gravel should be at least as hard as hardened cement mortar. Broken stone should pass a 2½-inch ring, and gravel should not be larger than to pass a 2-inch ring. The proportions for extraordinary strength may be 1C., 2S., and 4 broken stone or gravel. The proportions of sand and

stone for ordinary work may be 1C., 3S., and amounts of stone or gravel up to 8 parts.

Guesswork mixtures should never be made, for such methods give concretes of varying composition. Provide measuring boxes for the materials. These are best made of 1¼-inch stuff about 14 inches wide, and box shape; the sides to project beyond the ends for handles and to have no bottom. Provide a good, large platform, if mixing is to be done by hand. The exact proportions to be used depend on the nature of the work, and have the voids in the coarse material fill with the mortar, and when once determined they should be rigidly adhered to until the completion of the job in hand.

Measure out the stone and gravel on the mixing board and wet them thoroughly. Measure out the sand separately and put the dry cement on the sand and mix by turning twice, then throw the dry sand and cement on the wet rock or gravel and turn once. This will coat the coarse material with cement, and the mixture will be about wet enough, but add a measured quantity of water to the mixture and turn twice more. A properly mixed concrete should not quake while being shoveled or wheeled in a barrow, but it must be wet enough to quake when heavily rammed in place. A concrete that is too dry requires too much ramming. A concrete that is too wet takes more labor than one that is wet just right, for of the wet concrete you cannot get a good shovelfull and it slops out of a barrow in wheeling.

Concrete must not be disturbed when setting, and should be allowed to harden sufficiently before being used in such way as to damage the work. I have put in Portland cement one day and had loaded teams driving over the same in 24 hours after without fazing the surface. This was in warm weather with everything working right. In hot weather the surface of concrete must be kept damp, and it is a good thing to put 4 to 6 inches of wet sand over the surface as soon as the set has taken place, to prevent too rapid drying.

Concrete can be put in in freezing weather, if covered with earth or manure, and it must not be allowed to freeze until the excess of water is gone. Portland cements stand freezing much better than natural cements. If more than 8 inches to 10 inches of concrete is to go in it is better to put it in 2 layers. About 7 inches or 8 inches in depth of concrete is about the greatest thickness that can be properly rammed. Thorough mixing is essential to develop the full strength of concretes. I have had no experience with mechanical concrete mixers, but I have no doubt that they are better than hand labor, and pay where the work is of any considerable extent.

Concrete cannot be rammed against soft ground like that between piling or on sandy ground. In the first case it is better to throw in broken stone and tamp down, and in the second case the ground should be planked over to tamp against. Before starting concrete the excavation should be accurately levelled and plenty of stakes given for top of each concrete layer so the work may be kept true. A good surveyor's level should be used for giving levels, and around construction work an instrument of this kind soon pays for itself.

Nearly all bricks are more or less porous. In some localities one can get brick burned in down draft kilns of such material that they are absolutely non-porous. The amount of wetting a porous brick should have depends on the weather conditions in which we are constructing our cement masonry. In cold, freezing weather they should be used dry from the kiln; in ordinary weather porous brick should be wet but not soaked. If brick are packed or piled in regular order the inside of the pile cannot be properly wet. For this reason it is well to dump brick so they can be wet by water from a hose and the water can get at the brick. The idea is to get the brick uniformly wet. It is difficult to make good brickwork when some of the brick are soaking wet and others about kiln dry. A brick that is soaking wet will float on the mortar and slip or sink. A brick that is dry absorbs water from the mortar so quickly that it will not bed down and will make a thick joint.

It is quite usual to specify a ¼ inch joint for laying brick with cement mortar. In using vitrified brick, I have found it practically impossible to make as thick a joint as ¼ inch, and the brick measured hardly a ¼ inch more in the work than when stacked up dry.

The mortar for vitrified brick has to be very stiff or the brick will float. On the other hand, I have put in engine foundations for 250-horse power compound condensing engines in freezing weather, and the brick measured a full ¼ inch more in the work than when laid up dry, and the work proved satisfactory. If water enough had been used to bed these brick down to a ¼ inch joint the work would undoubtedly have frozen out.

In starting a job of brickwork it is best to take a good brick mason and let him bring up a lead with an easy working joint. Measure what he makes the courses and you can then figure out your courses of brick as to heights, as window sill, story, or wall plate heights. If the courses do not come right, the joints can be altered a trifle to make the work come out right. It is well to mark off the courses on say a 16-foot hole, and by starting the work level at the plumbing points the work is quickly checked up.

In making cement mortar for brickwork always measure the sand and water in proper proportions. It is essential for the best results that the mortar should be prepared and used suitably and intelligently. Good, thorough working improves the strength of mortar. For every 2 masons laying brick with cement mortar, a laborer should be employed to keep the mortar tempered up on the mortar boards with a square pointed shovel, and keep brick handy for the masons. Mortar boards should be about 3 feet square. Cement mortar that has become set should never be worked up anew with water. All cement mortar must be used up clean and none left over the noon hour. Do not leave dry cement mixed up with damp sand, as it will not make good mortar if left over night.

The proper way to lay brick in cement mortar is for the mason to take on his trowel enough mortar to properly bed one brick only, place the mortar, then push the brick into its place and cut off the surplus mortar. All brickwork should be properly bonded and a header say every sixth course. Brickwork should never be grouted in under any circumstances, if a thoroughly good job is wanted, and particularly if it is for water tight work, as a holder tank.

Sometimes in heavy walls a couple of courses of brick are run on the outside, then soft mortar dumped in and the brick placed therein. Bricks put in in this way are sure to have air bubbles under them. I have cut through work of this kind and found a considerable number of bricks under which a piece of writing paper could be shoved for fully ⅔ of the area of their beds. Mortar that is very soft or grouted will also show shrinkage in the vertical joints. To get the best work only enough mortar should be taken at a time on the trowel to properly set one brick. It is good work for a mason to lay 1,000 brick in 8 hours; that is, by actual count. You will find statements that 2,500 or 3,000 brick should be laid in 10 hours. This is at a rate of 250 to 300 brick per hour, or say 4 to 5 brick a minute. The average weight of a wet brick is at least 5 pounds, and mortar to lay the same at least 3 pounds, or 8 pounds per brick. It is practically impossible for a man to handle 2,000 to 2,500 pounds of material in one hour with his hands and only a trowel for a shovel, let alone keeping his work to line and properly bonding it. A man may lay 4 or 5 brick in a minute, but he cannot keep up that speed.

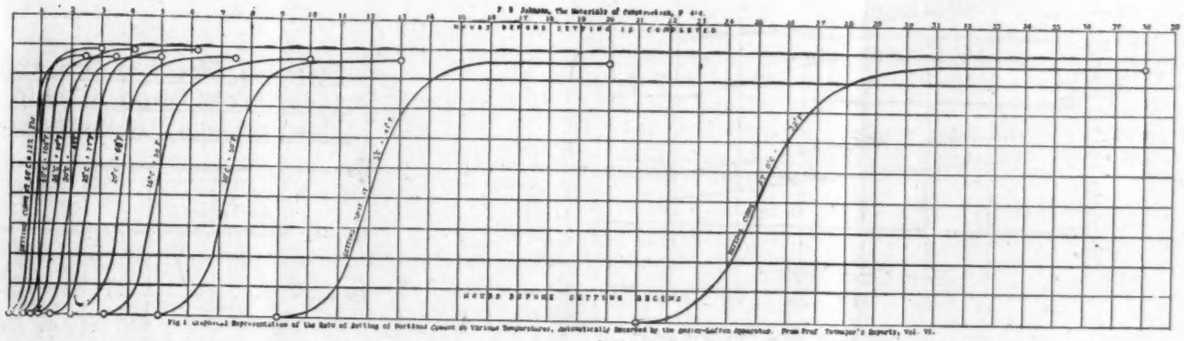
Holder tank walls and foundation walls should be racked back and a toothing left in which to join fresh work. In joining brickwork, or stone or concrete, the set work should be cleaned off thoroughly, dampened with water, and then dusted with a little dry neat cement. In this way a good joint or weld can be made with the fresh work to the new set work.

I cannot go into the merits of different building stone or definitions of kinds of stone masonry. Brick and concrete have supplanted stone masonry in many cases where formerly stone was regarded as indispensable.

For strength and durability, all stone should lie on their natural beds; each stone should be fitted in its place dry and then bedded in mortar. The surface of stone should be clean and damp, but not wet. There is enough moisture in even a stiff mortar to wet the stone, except perhaps in warm, dry weather. It is difficult to prevent the formation of large air bubbles under dimension stones.

In setting large dimension stones, such as engine beds, pier copings, column base stones and the like, I allow for a 1 inch joint to bed the stone. I then set the stone on hard wood wedges and clamp it in place by the foundation bolts. I then take Portland cement with an equal portion of coarse sand and just dampen the mixture. I tamp this mortar in the joint under the stone with a hardwood tamper or a steel bar. In this way a large stone can be set more quickly and accurately, and the bedding is stronger than by lowering the stone into a bed of ordinary cement mortar; besides, the work can be done with ordinary labor. Engines, pillow blocks, floor stands and all heavy machinery set on a stone or brick foundation can be securely bedded down with cement mortar in the same way. The machine can be accurately set on hardwood wedges and bolted into place, and the mortar tamped in to the the joint. Water should only show slightly when the mortar is thoroughly compacted in place.

I think if one has had little or no experience in putting in cement masonry and reads some of the literature on the subject, he is liable to get the idea that it is necessary to make elaborate tests of the cement that he may wish to use in order to get a suitable quality. We know as manufacturers of illuminating gas that the larger part of the com-



J.B.Johnson, Materials of Const., P. 411.

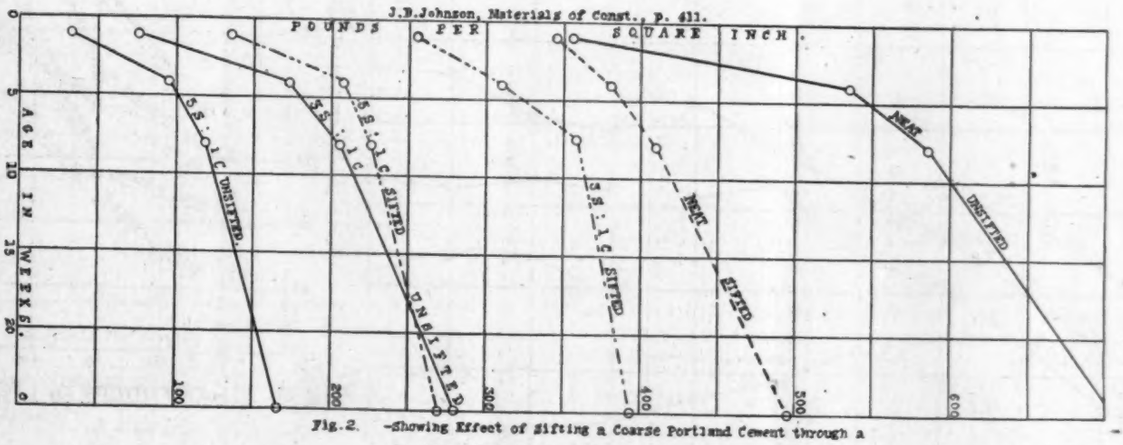


Fig.2. -Showing Effect of Sifting a Coarse Portland Cement through a No 180 mesh Sieve. (Trans. Inst. C.E., Vol. 84.)

— EFFECT OF VARYING PER CENT OF WATER —
— NEAT CEMENT —

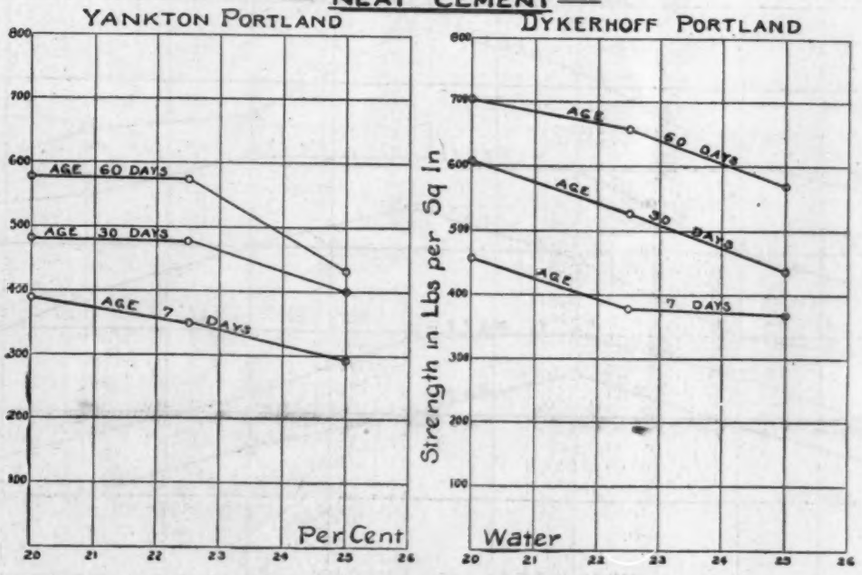


Fig.3. — Experiments by I.N.Knapp. — Fig.4.

— EFFECT OF VARYING PER CENT OF WATER —
— MILWAUKEE CEMENT —

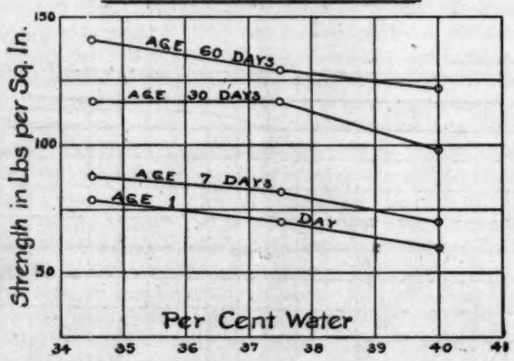


Fig. 5. — Experiment by I.N.Knapp —

Showing Effect of Screening Cedar Creek Sand 1C to 1S. by Measure with Milwaukee Cement

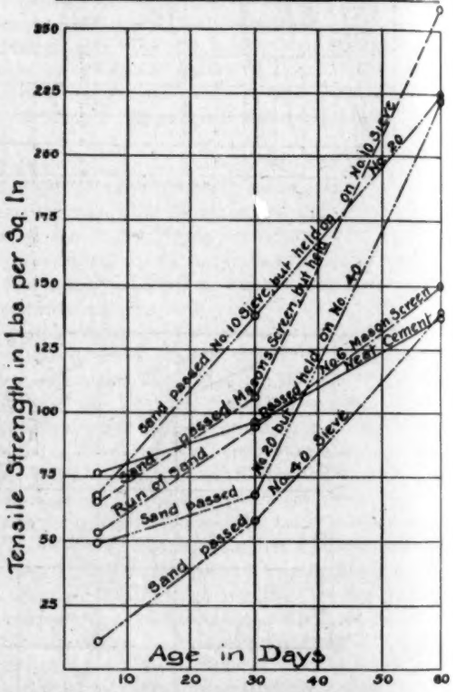

Tensile Strength in Lbs per Sq. In
Sand passed No. 10 Sieve, but held on No. 30 Sieve
Sand passed Mason's Screen, but held on No. 40
Run of Sand
Sand passed No. 20 but held on No. 40 Sieve
Sand passed No. 40 Sieve
Neat Cement
Age in Days

Fig. 8. Experiment by I.N.Knapp.

J.B.Johnson, Materials of Const., p.421.

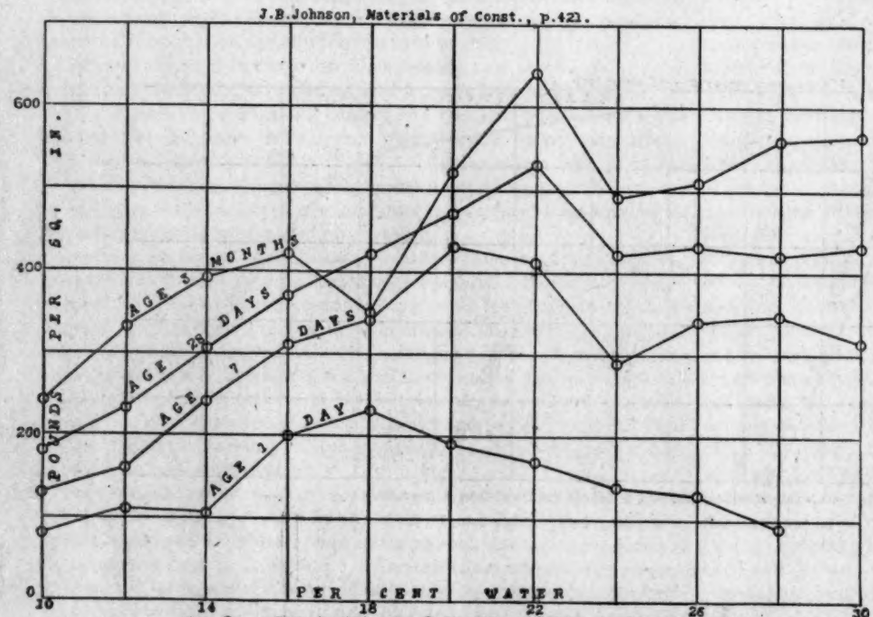


Fig. 6. - Effect of Varying Percentages of Water in Gagueing Neat Portland Cement.
(Jour.West.Soc.Engrs., Vol. I. p. 82, Table XVIII.)

J.B.Johnson, The Materials of Construction, p. 423.

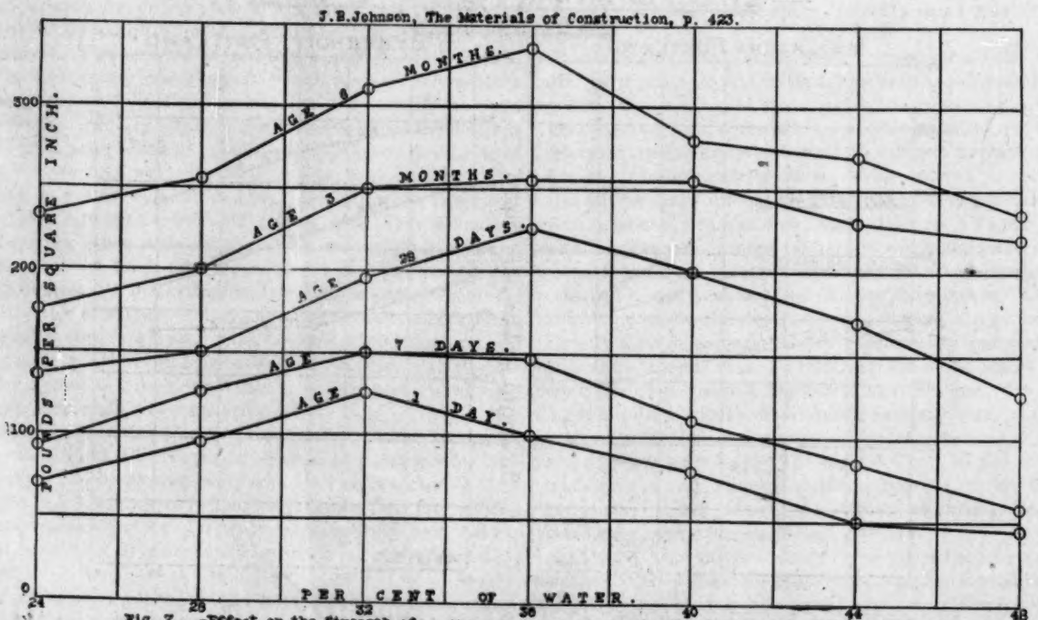


Fig. 7. -Effect on the Strength of a Natural Cement, Neat, of a Varying Percent of Water in Gauging.
(Jour. West. Soc. Engs., Vol. I. p 82, Table XVI.)

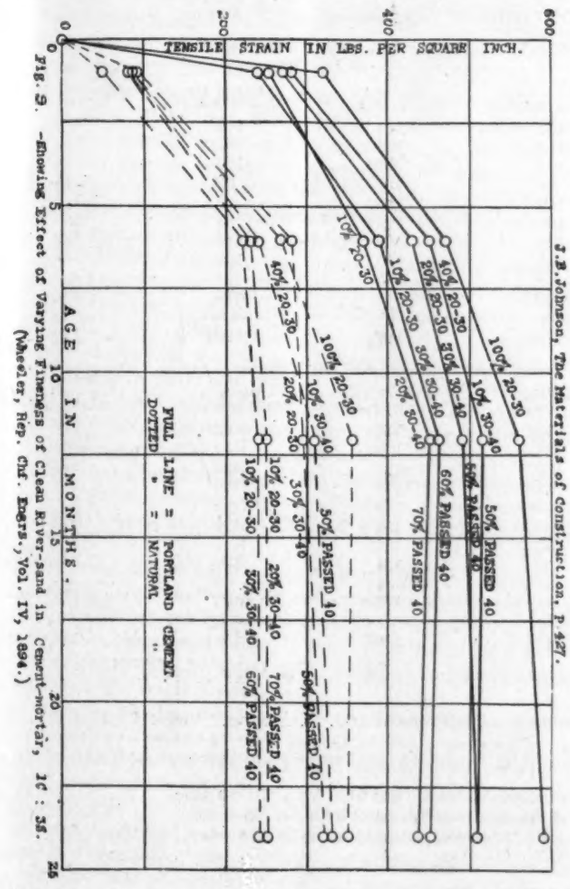
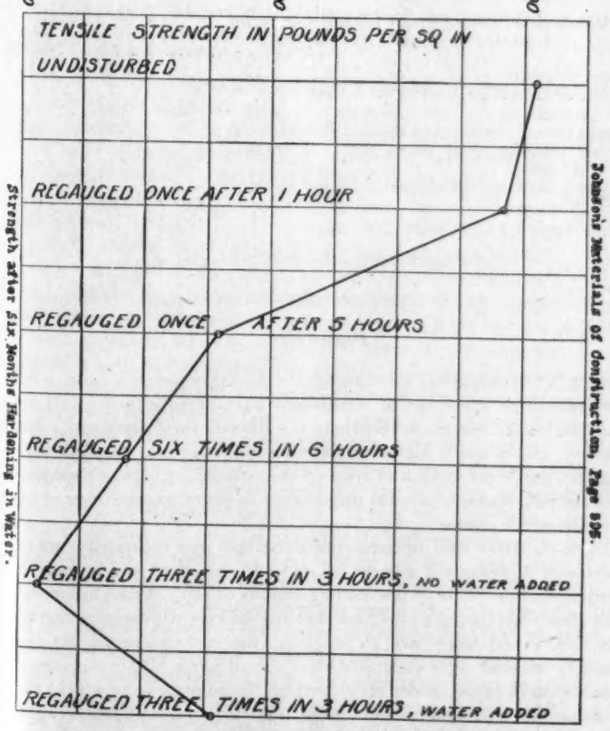

TENSILE STRAIN IN LBS. PER SQUARE INCH.
AGE IN MONTHS.
FULL LINE = PORTLAND CEMENT.
DOTTED " = NATURAL "
J.B. Johnson, The Materials of Construction, P. 427.

Fig. 9. -Showing Effect of Varying Fineness of Clean River-sand in Cement-mortar, 1c : 3s. (Wheeler, Rep. Chf. Engrs., Vol. IV, 1894.)


TENSILE STRENGTH IN POUNDS PER SQ IN
UNDISTURBED
REGAUGED ONCE AFTER 1 HOUR
REGAUGED ONCE AFTER 5 HOURS
REGAUGED SIX TIMES IN 6 HOURS
REGAUGED THREE TIMES IN 3 HOURS, NO WATER ADDED
REGAUGED THREE TIMES IN 3 HOURS, WATER ADDED
Strength after Six Months Hardening in Water.
Johnson's Materials of Construction, Page 396.

Strength of Regauged Neat Portland Cement. (Wheeler, Rep Chf Engrs 1895, p 2979)

Fig. 10.

plaints of the quality of the gas comes from its poor and improper use, and also that a large part of the gas we sell is not used to good advantage, so as to develop its full value for lighting and heating.

The manufacture of hydraulic cements has been established for a term of years, and I believe it is better for the gas superintendent or manager to rely on the ability of the cement manufacturer to supply a uniform grade of goods suitable for his use than to go into any hair-splitting testing of cement. We should give the matter of the proper use of cement our closest attention when putting in cement masonry, and the results are sure to be satisfactory.

I regret that I did not start in to write up these notes a sufficient time before your Secretary wanted them to print, to get them in better shape; but such as they are I present them to the Association and hope they will prove to be of sufficient value to justify the time of this meeting that I have taken up.

TABLE A.—*From Engineering News, March 5th*, 1896.—Showing results of tensile tests of the same sample of cement, 1 part cement, 3 parts sand, made by different persons in accordance with their understanding of the method proposed by the committee of the American Society of Civil Engineers.

	1.	2.	3.	4.	5.	Aver.	Range in Pounds.	Ratio of Avr. to Max.	Water Per Cent.
No. 1. R. W. Hildreth & Company, New York.....	68	72	74	78	82	75	14	30.4	12.0
No. 2. Washington University, St. Louis, Mo., Prof. J. B. Johnson...	77	94	108	110	122	102	45	41.8	Not Known.
No. 3. City of Easton, Pa., H. R. Fehr, City Eng.....	106	112	123	.....	....	114	17	46.5	10.4
No. 4. 6 Columbia College, 144	125	126	130	137	140	133	19	54.0	10.0
New York, 153 Prof. W. H. Burr.	126	132	138	144	150	140	27	56.8	8.0
No. 5. Chas. F. McKenna, New York.....	148	150	151	155	160	153	12	62.0	12.0
No. 6. Cornell University, Ithaca, N. Y., Prof. F. P. Spaulding.....	155	160	164	166	172	163	17	66.0	Not Given.
No. 7. Lafayette College, Easton, Pa., Prof. J. M. Porter.	171	177	177	178	179	176	8	71.4	11.0
No. 8. Clifford Richardson, Washington, D. C.....	220	224	226	228	228	225	8	91.2	10.0
No. 9. Booth, Garrett & Blair, Philadelphia, Pa.....	240	246	249	250	252	247	12	100.0	12.0
Average of all.....						153	18	62.0	10.8

Figures are tensile strength in pounds per square inch.

TABLE B.—*Experiment of I. N. Knap. Yankton Portland Cement.*

20 Per Cent. Water. 7 Day Test.	22½ Per Cent. Water. 1 Day in Air.	25 Per Cent. Water. 6 Days in Water.
335	335	272
432	334	295
342	380	354
415	334	320
485	346	240
355	338	335
430	358	275
333	380	286
8)3,127	8)2,805	8)2,376
390⅞	350⅝	297
30 Day Test	1 Day in Air.	29 Days in Water.
420	442	386
509	481	372
505	490	454
437	464	420
481	470	340
546	441	454
544	525	380
411	505	400
8)3,853	8)3,818	8)3,206
481⅛	477¼	400¾

Table B.—Continued.

30 Day Test.	1 Day in Air.	5) Days in Water.
658	542	436
522	581	448
526	552	504
564	538	418
592	592	422
556	670	370
578	528	416
612	590	442
8)4,608	8)4,593	8)3,456
576	574½	432

TABLE C.—*Experiment of I. N. Knapp. Dykerhoff Portland Cement.*

20 Per Cent. Water. 7 Day Test.	22½ Per Cent Water. 1 Day in Air.	25 Per Cent. Water. 6 Days in Water.
415	400	352
408	375	390
475	354	412
477	380	325
473	387	358
476	355	373
454	373	398
471	395	337
8)3,649	8)3,019	8)2,945
456⅛	377⅜	368⅛
30 Day Test.	**1 Day in Air.**	**29 Days in Water.**
605	474	480
605	532	517
645	565	165
600	500	342
660	512	492
602	555	505
565	510	637
559	562	356
8)4,842	8)4,210	8)3,494
605¼	526¼	436¾
60 Day Test.	**1 Day in Air.**	**59 Days in Water**
690	632	520
690	612	504
610	692	570
700	744	624
810	640	614
760	658	612
717	628	604
635	655	518
8)5,612	8)5,261	8)4,566
701½	657⅞	570¾

TABLE D.—*Experiment by I. N. Knapp. Milwaukee Cement.*

34½ Per Cent. Water.	37½ Per Cent. Water.	40 Per Cent. Water.	37½ Per Cent. Water.
24 Hour Tests.			
1 Hour in Air. 23 Hrs. in Water.	1 Hour in Air. 23 Hrs. in Water.	2 Hours in Air. 22 Hrs. in Water.	5 Hours in Air. 19 Hrs. in Water.
59	71	61	79
61	63	62	87
88	72	62	83
75	71	60	74
124	72	61	76
69	70	62	75
81	69	59	70
76	74	57	74
8)633	8)562	8)484	8)618
79½	70¼	60½	77¼
7 Day Tests.			
1 Hour in Air. Rest in Water.	1 Hour in Air. Rest in Water.	2 Hours in Air. Rest in Water.	1 Hour in Air. 4 Days in Water. Rest in Air.
93	88	73	110
84	94	76	125
92	84	64	94
104	74	70	116
97	80	73	95
80	80	71	104
62	88	72	92
94	75	65	98
8)706	8)663	8)564	8)832
88¼	82⅞	70½	1 4

TABLE D—*Continued. Experiment by I. N. Knapp. Milwaukee Cement.*

34½ Per Cent. Water.	37½ Per Cent. Water.	40 Per Cent. Water.	37½ Per Cent. Water.
30 Day Tests.			
1 Day in Air. Rest in Water.	1 Day in Air. Rest in Water.	1 Day in Air. Rest in Water.	1 Day in Air. 4 Days in Water. Rest in Air.
102	124	104	120
115	109	87	124
128	115	105	118
84	126	92	115
149	125	97	128
129	123	88	127
102	109	113	132
131	110	100	130
8)940	8)941	8)786	8)994
117½	117⅝	98¼	128¼
60 Day Tests.			
1 Day in Air. Rest in Water.	1 Day in Air. Rest in Water.	1 Day in Air. Rest in Water.	1 Day in Air. 5 Days in Water. Rest in Air.
143	130	92	143
122	122	154	165
130	127	122	142
152	128	124	177
153	124	126	159
139	132	112	151
145	141	115	157
150	131	132	143
8)1,134	8)1,035	8)977	8)1,237
141¾	129⅜	122⅛	154⅝

TABLE E.—*Experiment of I. N. Knapp. Cedar Creek Sand.*

Sand passed by a mason's No. 6 screen and thoroughly dried ...	100 oz.
Passed a mason's screen, but held by a No. 10 sieve	14 oz.
Passed a No. 10 sieve, but held by a No. 20 sieve	30 "
Passed a No. 20 sieve, but held by a No 40 sieve	31 "
Passed a No. 40 sieve	25 "
Total	100 oz.

Milwaukee Cement and Cedar Creek Sand, 1C., 1S. by Measure.

	7 Days.	30 Days.	60 Days.
Neat cement	70	96	138
Run of sand as passed a mason's No. 6 screen	53	95	150
Sand passed screen, but held on No. 10 sieve	67	106	259
Sand passed No. 10 sieve, but held on No. 20 sieve	65	138	225
Sand passed No. 20 sieve, but held on No. 40 sieve	49	68	223
Sand passed No. 40 sieve	11	58	139

All figures the average of 8 briquettes.

Discussion.

Mr. A. C. Humphreys considered Mr. Knapp's paper a most admirable example of the value of completely harmonizing theory and practice. The writer was an acknowledged authority on cement and cement masonry, and it was a matter of extreme importance to the Association to have a paper prepared and read on this subject, which, although not a gas subject, was one of vital importance to every gas engineer at some time during his career.

Mr. A. S. Miller said his experience the last year indicated it was not safe to rely on brands of cement which had been tested and been proven themselves true. One of the leading brands of cement had fallen down badly this year, owing to the fact that the makers were producing more than they could take care of properly, the raw materials not being carefully selected. He suggested that for all work which could not be replaced (as in large holder construction) the cement be carefully tested by some one who understands more than the ordinary breaking test. It was very important to ascertain whether there was an excess of magnesia in cement, for an excess would cause it to crack and to disintegrate in time. He thought the statements in the paper might lead one to err by using the mortar and concrete too dry. While cement would be stronger if an excess of water were not used, on the other hand plenty of water in the cement would enable better work to be done, and that would more than compensate for loss of strength in the cement. He found it practically impossible to compact dry cement properly and

firmly unless the workmen were watched. Consequently dry concrete would cost more than it was really worth. A conscientious workman would have very little difficulty in tamping fairly wet cement until it was compacted. If concrete or mortar for brickwork were made pretty dry the chances seemed that when the job was finished there would be many voids in either one. Referring to the statement by Mr. Knapp that it was a mistake to dump a lot of mortar on the wall and place brick in that mortar, because there would be air under the brick, Mr. Miller thought there would be less air under the brick if the mortar were put into the wall as described, and the brick then slid along to its position, than there would be if the brick were laid flat on top of a trowel full of mortar, for the reason that in putting mortar into a wall a mason always puts the point of his trowel into the mortar and draws the trowel along, and this always leaves a big hollow under the brick. He cannot do this if the wall is filled and the brick then slid into position.

Mr. Littlehales said that the purchasing of cement was the same as the purchasing of other materials. It was not an unusual thing to get the label of one maker on the material of another. It was not, therefore, safe to rely altogether upon the brand, but tests should be made to confirm the reputation of the supposed maker.

Mr. Egner inquired if Mr. Knapp had ever used salt when doing cement work in freezing weather. This had been recommended by United States army engineers. He had tried it, and found it of some advantage.

Mr. Prichard did not believe that cement was usually properly mixed by machine. Thorough mixing and tamping were essential to good work. He had frequently noticed concrete mixers turning out concrete in which the cement was perfectly dry. To secure a good concrete job the materials should be thoroughly mixed, then put on the job, and tamped until the water just starts.

Mr. Woodward thought that by many of the machine mixers in use it was possible to secure a better mixing of the concrete that was possible by hand. He had recently to look after a considerable amount of cement work where the mixing of the concrete had been done by machinery, and the work showed it to have been most satisfactorily done. The buildings were made of concrete blocks, which had been colored in imitation of brownstone by the admixture of venetian red. The mixture was thorough all the way through the blocks, and this could not have been secured by hand mixing. His experience had led him to thoroughly believe in machine mixing; in fact he thought that was the only way in which a thoroughly homogeneous mass could be secured.

Mr. A. S. Miller desired to emphasize what the last speaker had said in regard to the importance of machine mixing. If he had any important work to do where the concrete was to be strained unusually fine, even if there were not more than 10 yards of it, he would put the concrete through a mixer. He did not believe that a man in a day's work could make as good a mixture as could be obtained from a revolving mixer in 5 minutes.

Mr. R. B. Brown said that during the last year, in Milwaukee, he had had occasion to lay 10,000 yards of concrete, and found that with a mixer it was possible to so mix the concrete, whether with large or small agglomerates, and whether with a large or small addition of water, that every stone would be uniformly coated with the cement mortar. It would have been difficult, if not impossible, to secure the same result by hand mixing. Mr. Brown wished also to emphasize what had been said with respect to tamping dry concrete. Recently in the construction of new bridges in Milwaukee a number of pits were required which were intended to be water tight and which extended several feet below the surface of the river. The concrete for the pits was mixed dry and tamped under all kinds of supervision. Every pit now leaks, proving that the voids had not been all filled. He had recently had a similar experience in his own work on a pit which had been subjected immediately after the pumping was stopped to a pressure of over 14 feet of water. What is known as soup concrete was used. It had been poured in but not tamped, except as the men walked through it. The water had been allowed to accumulate outside the walls within 3 days after the concrete had been stripped. The pit was absolutely tight, showing that the voids were well filled, and that there had been no shrinking of any account by settlements taking place during the setting. He would ask Mr. Knapp if there were not serious danger of cement being sent out without proper ageing. He found that the 30-day test did not always turn out the same as the 7-day tests. Might not this be due to the fact that the cement had not been sent out immediately after being ground?

Mr. Knapp. in replying to the questions and criticisms, said that in using cement for brickwork it was better that the workman take only sufficient mortar on the trowel to lay one brick at a time. He was then more apt to push the brick properly in place. Did he put down but one trowelful of mortar at a time he would not be apt to point in the trowel so as to make a hollow in the mortar. He did not think the presence of magnesia in cement was due to turning it out too fast, but might be due to insufficient burning. He had tried the use of salt in cement in freezing weather, but had not found it as satisfactory as the use of proper precautions to lay the bricks dry, and to cover up the work. He did not believe that much of the cement sent out the past year had been properly aged. It seemed to him that with a machine mixer a much more thorough mixing could be obtained than was possible by hand mixing. He had been told by a manufacturer of concrete mixing machinery that the proportion of good Portland concrete to sand had been brought down to 1 to 12, and that concrete in this proportion was being used on levee work on the Mississippi river. With thorough mixing he believed the quantity of cement used could be very considerably reduced. He doubted if any cement masonry could be made thoroughly water tight without the use of an impervious coating on the side of the pressure.

[To be Continued.]

Hot Water Heating From a Central Station.

In a paper on this subject, read by Mr. E. H. McKnight at the last meeting of the Ohio Electric Light Association, the author said:

Owners of electric light plants have long desired to increase the earning capacities of their properties without appreciable additional expense. This has led to an investigation of the utilization of exhaust steam as a means of heating buildings. Wherever this business has been added to an electric light plant it has proven its salvation, especially where competition has been keen and profits small.

The purpose of this paper is to give a general idea of the equipment and operation of such an enterprise.

Details of Construction.—Pumps and condensers, or heaters, an expansion tank and a catch-all constitute the equipment of the station. Large duplex pumps are used to circulate the water about the system. They are operated at a low pressure during moderate weather, but in extreme cold weather the pressure is increased.

An open tank of sufficient capacity is placed at an elevated position, and used as an expansion tank for the system. Any good condenser or open heater into which the exhaust steam from the engines is turned can be used. The condensation formed is conducted back to the boiler by means of a small automatic pump, furnishing a quantity of heated water free from impurities, the oil having been extracted by means of the catch-all. The water for the heating system is pumped under pressure into the condensers or heaters, and becomes heated, passing out of the condensers or heaters and continuing its travel about the circuit. The condenser should be of ample size to heat sufficient water to care for the amount of radiation installed. A continuous and uninterrupted service during the heating season is assured by having all station equipment in duplicate.

The Mains.—Upon leaving the station, from 8 to 12-inch pipe is used, this depending upon the capacity of the system; the size of same is reduced at intervals, until the end of the line is reached. The 2-pipe system has many advantages, in my opinion, over a single pipe system; one pipe being used for the supply, and the other for the return. With this arrangement water is brought directly into each building from the heating apparatus, not having passed through any other building.

The insulation of the mains is a matter which necessitates much care and attention. The material which has been found to be the most efficient and inexpensive consists of hemlock boxes, built with double air-tight compartments in which the mains are laid; the space remaining about the pipes being well filled with process shavings or mineral wool. The outside of the boxing is protected by a prepared building paper.

Where this kind of insulation has been used the loss of heat on the line amounts to not more than 15 to 20°; that is to say, when water is sent out at 180°, it will return to the plant at 160°. Thus when this water is raised from 160° to 180°, it is ready to send out again. Care should also be taken in anchoring the mains and providing for expansion.

Cost of Operation.—The expense of operating the heating plant under ordinary conditions is not great, the principal expense being in the amount of live steam used to operate the circulating pumps, which at no time is any great amount, the total for the entire heating season being a comparatively small item. No extra labor is needed at the plant,

what little attention the heating plant may require can be given by the same force of men heretofore employed at the electric light plant.

In order to fully realize upon the investment at the earliest possible time, it is most desirable to secure the services of one who is thoroughly conversant with the details of the business and familiar with the method of figuring for the purpose of making contracts for the heating of every available building located upon the pipe line.

As soon as the capacity of the pipe line has been reached, this additional expense can be dispensed with.

Method of Figuring.—The rules used are the same as those given by the highest authorities on the subject of heating, and are the same as those which have been in general use for a number of years.

In determining the amount of heat a given building will consume, measurements are taken of the cubic contents of each room, it being assumed that the atmosphere of a room changes once and must be reheated. The square feet of exposed glass surface is also measured, the loss of heat through 1 square foot of glass being 75 times as much as the heat consumed by 1 cubic foot of air. Next the square feet of exposed wall surface is taken, it being estimated that 10 square feet of wall surface, in the average well-built house, will lose as much heat as 1 square foot of glass surface.

By this means we arrive at the total number of feet of radiating surface to heat a given building, allowing 1 square foot of radiating surface for every hundred feet of cubic contents or its equivalent. An erroneous impression has gone forth to the effect that the heat is charged for according to the number of feet of radiation used, whether this be much or little; but in reality the cost per year is governed by the amount of heat the building will consume, and is not based entirely upon the number of feet of radiation contained in it. It is a well-established fact that hot water as a heating medium is far superior to all other known methods of heating. Among the numerous advantages to be had from this particular method is the fact that during the fall and spring months when a moderate amount of heat is desired, this need can be supplied by circulating the water at a low degree of temperature.

The heat from such a system is supplied to the consumer 24 hours a day and every day upon which heat is needed; the service being continuous and uninterrupted, it gives the consumer the least concern. A crowning feature of this system of heating is obtained by the use of heat regulators, one or more being placed in each building. This insures an even, regular temperature through the house at all times.

Pumps and Other Mechanical Accessories in Electrochemical Plants.

In a paper read before the Electrochemical Society, which is valuable on account of the large amount of the technical information given in in it concerning details, David H. Browne, Cleveland, O., points out that the successful conduct of any electrochemical process depends to a large extent upon the practical solution of the mechanical problems involved. He gives in a humorous style a very interesting account of his struggles with pumps, heaters and other mechanical accessories, as he had to handle for several years a hot concentrated solution of chloride of copper and nickel, with some free chlorine, some hydrochloric acid, and a lot of impurities, such as sand, graphite, copper sulphide, metallic particles, chips of wood, etc.

First, he records a long series of unsuccessful trials with various arrangements, all of which had to be finally discarded; but when this paper will be printed in full, it will be interesting reading, because the author not only describes the unsuccessful arrangements, but also says why they were unsuccessful. When the problem of evaporating and concentrating large amounts of solution became important, they devised a concrete evaporating pan of the following construction: The base of this evaporator was built of brick, the top course being laid in cement, and a cement coat with a slight slope to the front being laid over the top of the brickwork. On this platform was built a shallow concrete pan with sloping sides; a wall down the middle divided this into two equal compartments, which communicated with an opening in the party-wall; they were covered by heavy tiles. While the solution is flowing through, any crystals settling out are raked off the bottom up the sloping sides to a trough. A chimney assists in drawing a current of hot air from the brick oven heated by an oil burner. While this apparatus was successful to some extent, there were two sources of trouble; the coating of the solutions with a floating layer of crystals, and the cracking of the concrete due to alternate heating and cooling. The trouble due to the coating of salts covering the surface of the liquid suggested to them an idea of an evaporator in which a very thin film of solution is continually exposed to a stream of hot air.

The apparatus consists of an iron shell, closed at the upper end by a circular lip, and at the lower end by a similar, but more shallow lip. This shell is lined with bricks and cement and is rotated by a peripheral driving gear. An oil burner in a brick furnace to one side produces a current of hot air, which entering the evaporator by a sleeve, passes along the top of the arch, meeting there a film of liquid which is continuously dragged up from the pool. The solution flows in continually and flows out continuously over the lip through a ring opening around the air sleeve. Any crystals separating are carried in suspension into a tank where they settle out, while the solution passes on towards the pump pit. At first they used a fan to draw the air through, but they found out that better results were obtained by checking the air flow to such an extent that the exit gases were nearly saturated with moisture. He recommends this apparatus as very satisfactory; for further details and illustrations we must refer the reader to the full paper.

When a pump is made of parts—generally three main parts—he recommends to assemble the three main parts in a box, laying the pieces close together without gaskets between. Around these pieces granite concrete is rammed, and the block allowed 3 or 4 days to harden before removing the box. To provide for the bolts which hold down the valve checks and the piston gland, short pieces of iron pipe may be laid in the box before the concrete is rammed in, or still better, T-shaped slots may be provided in the concrete by suitable wooden forms nailed against the side of the mould. A 3-piece pump so mounted is practically one solid block of stone. It requires no fastening, can be laid on the floor anywhere, and is very readily lined up beneath a driving shaft. As a gasket for this style of pump he has found common felt well soaked in P. & B. paint to be a good substitute for hard rubber.

Recently, they also used pumps made in one piece. Such a pump is very easily mounted in a concrete block. One end is provided with a skeleton ball check, which acts both as a check and discharge opening. The exit pipe is coupled to this by a flat flange and hard rubber nipple. To hold down the check and the piston gland they use a heavy cast iron plate with two claws on each side, against which the bolt heads or washers can be drawn up. This makes a very compact form of pump mounting.

As a suction pipe he uses either a section of a wood pump log drawn tight against the lower part of the pump body, or a hard rubber flange and nipple coupled to a length of flexible hose of sufficient wall thickness to withstand the collapsing strain. For discharge pipe he uses almost exclusively a permanent concrete main.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. Maynard H. Spear has been appointed Superintendent of Works to the Newtown and Flushing Gas Company, of Flushing, N.Y., vice Mr. O. H. Fogg, resigned. Mr. Spear is a graduate of Stevens Institute, and much of his tuition in the gas business was obtained under the direction of Mr. Geo. E. Woods, Superintendent of Manufacture of the Consolidated Gas Company, of this city, when that gentleman was Chief Engineer of the Standard Gas Light Company, of New York.

Mr. O. B. Weber, senior member of the firm of Adam Weber Sons, of this city, writes us that his firm has been awarded the contract for putting in the new coal gas plant for the Halifax (N. S.) Electric Tramway Company. The contract calls for the placing of 16 benches of 6's, equipped for firing on the Weber plan, and designed to use the Dominion coal for fuel. A feature of the contract is in the specification declaring that only skilled American labor should be employed on the work. The draft for each bench is to be maintained by chimneys of the Weber radial block type.

At the 54th annual meeting of the Consumers Gas Company, of Toronto, Ont., the election for officers resulted in the following naming: Directors, A. W. Austin, J. L. Blaikie, Henry Cawthra, G. R. R. Cockburn, I. C. Gilmor, Geo. Gooderham, James Henderson, Thos. Long, E. B. Osler, L. W. Smith, A. J. Somerville and Thos. R. Wood; President, L. W. Smith; Vice-President, G. R. R. Cockburn; Secretary, Treasurer and General Manager, W. H. Pearson. The following extracts, taken from the annual report of the President, show that the Company prospers:

"The net profits, as shown by the statements, afford evidence of an increasing business. The system of coal and coke conveying machinery has been completed, and so far has worked satisfactorily. A new stack

of 16 benches of 'eights' has been erected, and a battery of 3 marine boilers is being installed. During the past year 2,314 new services have been put in, and—including the 'Island'—11.45 miles of mains have been laid, making a total of over 268 miles. All the space in the retort house is now occupied, and it is expected that, during the coming winter, the capacity of the works will be taxed to the fullest capacity. Owing to the protracted coal strike the Company has not been able, for a considerable time, to obtain any anthracite coal for its water gas plant, and has been obliged to use coke instead. The scarcity of anthracite coal has caused a great increase in the consumption of gas for fuel purposes, and considerable difficulty has been experienced in getting an adequate supply of bituminous coal for the coal gas works. However, arrangements have been made with the contractors to forward such shipments as, it is anticipated, will keep the Company amply supplied in the future. The illuminating power of the gas, as shown by the weekly reports of the Government Inspector, has always been considerably in excess of the legal standard. The following statement for the past, as compared with the preceding year, shows:

	Street Lamps.	Meters.	Gas Rental.
Year ending 30th Sept., 1902..	923	30,812	$771,982.40
" " " " 1901..	916	28,584	716,524.82
Increase	7	2,269	$55,457.58

"The works, owing to the extensive improvements recently effected, have never been in a higher state of efficiency."

A CORRESPONDENT in St. Louis, Mo., forwards the following under date of the 1st inst.: "Among the suits recently decided in the Supreme Court was that of Manning Mayfield of this city, against the Alton (Ills.) Railway, Gas and Electric Company, for damages in the sum of $5,000. The decision was adverse to Mr. Mayfield. Some years ago a consolidation of the Alton Railway, Gas and Electric Company and the Alton Railway and Illuminating Company was effected and the combined capital stock was fixed at $500,000, which was double the stock of the theretofore companies. Mr. Mayfield held 50 shares of stock in the Alton Railway and Illuminating Company, and objected to the consolidation. He entered suit for the par value of the stock, alleging that he had been subjected to financial loss by the consolidation on the ground that the assets had not been increased in proportion to the increase in stock. The Supreme Court decided that, inasmuch as two-thirds of the stock was voted in both corporations for the consolidation, Mr. Mayfield had no recourse, and lays it down as a principle that two-thirds of the stock of any two corporations is a legal majority for effecting a consolidation."

A CORRESPONDENT in Baltimore, Md., writing under date of the 3d inst., says: "Anent an item in the JOURNAL dated to-day, in which 'A Correspondent from Baltimore' states that the Stettiner Chamotte Fabrik has secured a contract in England in competition with or against all English systems. Permit another, but only by chance, correspondent from Baltimore to specially call attention to the first Baltimore correspondent's statement wherein he says that these retorts are to be 20 feet feet long, which is most decidedly an English, and to date not at all a German practice. The German engineers at their recent annual meeting themselves called attention to the fact that larger retorts were being successfully used in England and advised the following of that practice. Your American readers should not forget what our friend Mr. William R. Beal said in his late Presidential address before the American Gas Light Association on that very subject. He insisted on longer retorts, with the Germans. They tried them at Posen, at his suggestion, and were pleased with them. Your correspondent from Baltimore will probably admit that there are a good many Germans who have sense enough to know a good thing when they see it. Why shouldn't they improve? even if they are Germans. If that correspondent from Baltimore will call on me—if he is still here—I shall make him 'set em up'."

A CONTROLLING interest in the Centralia (Ills.) Light and Power Company has been sold to a syndicate consisting of M. M. Stephens and W. S. Forman, of East St. Louis, Ills.; L. D. Turner, of Belleville, H. M. Byllsby and J. S. Cummings and L. F. Bundry, of Centralia. The officers of the new Company are: President, M. M. Stephens; Vice-President and General Manager, H. M. Byllsby; Secretary, L. D. Turner; Treasurer, Henry Kohl. The new managers propose to greatly improve and extend the gas and electric divisions of their property—if we mistake not they have succeeded to in securing control of the local street railway system.

A SEEMINGLY well authenticated statement is to the effect that the Logan Natural Gas Company has purchased the artificial gas plants in Marion, Fremont and Bellevue, O., and has leased the plant of the City Heat and Light Company, of Fostoria, O., for a period of 15 years.

AN opposition concern has applied to the authorities for a franchise under which to operate the Brookhaven Gas Company, in the town of Patchogue, L. I. The Directors are Edwin Bailey, J. L. Gerety and A. H. Carman.

THE proprietors of the Swedesboro (Pa.) Gas Company have perfected the following organization: President, A. M. Worstall; Vice-President, Wm. H. McCullough; Secretary, C. E. Pugh; Treasurer, G. W. S. Brubaker. The contract for the construction of the manufacturing plant has been awarded to the United Gas Improvement Company.

MR. P. E. HALL, of Ashtabula, O., has been appointed Superintendent of the Everett (Wash.) Gas Company.

WE regret to report the death, in this city, the morning of the 27th ult., of Mr. Herman D. Kampman, formerly prominent in the gas and electric supply of San Antonio, Tex., having been President of the San Antonio Gas and Electric Company when its properties were purchased by the McMillin syndicate. Deceased was in his 46th year, having been born in San Antonio, September 7, 1857.

SOME adverse comment having been made over the policy of the old Auburn (N. Y.) Gas Company, in charging a much lower rate for gas in the districts of that city piped by the opposition concern than in the districts not so piped, the Auburn Company has put forth the following explanation: "The Auburn Gas Company has been subjected to a great deal of criticism because it has reduced the rate for gas where competition existed and not otherwise. We wish now to explain our position and reasons for taking this stand. The nearer that consumers are together and the greater the quantity used by each, the less the expense of maintaining the service and the less the investment per 1,000 cubic feet of gas sold. It is evident from this that the business districts and the large and closely built up residence parts of the town are the best of it from an earning standpoint and the ones in which a gas company looks to make its profits. There are miles of mains in this city that have been down for years that barely pay interest on the investment with gas at $1.35 per 1,000 cubic feet, and would be worthless at a lower figure. We have about 40 miles of mains, the new Company about one-eighth as much, yet it covers with the one-eighth investment at least five-eighths of the business. The opposition Company has cut its price below the cost of production. If we carried the entire city at this rate we would be carrying on the fight at a great disadvantage, which we cannot be expected to do."

MR. GEORGE WHYSALL, the enterprising General Manager of the Evansville (Ind) Gas and Electric Light Company, surprised the proprietors, and himself too, over the success that attended his campaign last season for the placing of gas ranges.

ALD. BROCKETT, of the Lincoln (Ills.) City Council, is endeavoring to have an ordinance passed under which the rates charged by the City of Lincoln Gas Company shall not exceed the following: For illuminating use, 90 cents per 1,000 cubic feet; for heating and power uses, 80 cents per 1,000 cubic feet—the rate in each instance is net.

THERE is a bill before the Vermont Legislature to permit the Brattleboro Gas Light Company to increase its capital stock to a sum not exceeding $200,000. Its present capital is $60,000, and it has a bonded indebtedness of $30,000.

MESSRS. H. A. FOSTER, W. B. Decker and N. J. Foster propose to build a works on the coal gas order at Fairbury, Ills. This place is a post village of Livingston county, Ills., and is about 12 miles by rail southeast of Pontiac. It is quite a manufacturing point and a good quality of bituminous coal is mined there. Population not in excess of 4,000. It may be that the parties named propose to put up a coke oven plant, using the salable gas for the needs of the residents.

THE new proprietors of the Albion (Mich.) Gas Light Company have completed the reorganization of that concern. Those in charge of its affairs are: Directors, Edward M. Deane, Chas. B. Kelsey, Eugene P. Robertson, Charles E. Temple and H B. Wales; President, C. B. Kelsey; Vice-President, H. B. Wales; Secretary, Chas. E. Temple; Treasurer, E. P. Robertson. Mr. Edward Schaedel, formerly connected with the Grand Rapids (Mich.) Gas Light Company, will be the resident manager of the Albion Company.

The Market for Gas Securities.

The share market in general put forth many queer symptoms last week, and he would be wise indeed who could correctly forecast the near future of speculative trading. It may be said, however, of shares in fairly well managed, and not altogether over capitalized, gas companies, that the outlook for such never was better. The returns on output account received by us on the average are greater than any heretofore returned, and the increase applies to the largest as well as the smallest companies. The trading in local gas shares was small in volume during the week. Consolidated closed today (Friday) at 216 to 220. Accredited city gas bonds are firmly held.

The dealings in Brooklyn Union were virtually nil, and whatever trading was reported was done at lower figures on the average than those recorded for some time. The close to-day was 224 to 230. Peoples, of Chicago, is steady, with a good demand for it from people who usually know they are "getting in right." Syracuse (N. Y.) gas securities are going on to better prices, and Baltimore Consolidated still exhibits strength.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

NOVEMBER 10.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	216	220
Central Union, Bonds, 5's.	3,000,000	1,000	110	112
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	350	..
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	112¼	113
Northern Union, Bonds, 5's.	1,250,000	1,000	108	110
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115¼	118
Yonkers	299,680	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	224	230
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1¼	1⅜
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works...	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10¾	11
" " Bonds, 5's	5,256,000	1,000	79	81
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	600,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co..	29,500,000	100	99¾	100
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,720	100	88¾	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore...	11,000,000	100	73¼	73½
Mortgage, 6's	3,000,000	..	..	118
Chesapeake, 1st 5's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	.	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s. Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50	.	89
" Prior Lien 5's	5,603,000	1,000	99¼	100
Detroit Gas Co., 5's	382,000	1,000	77	79
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	108
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2,650,000	..	103¾	104½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	84	85
Preferred	2,500,000	100	100	110
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	112	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	109¾
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	218	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	58	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	103¼	103⅝
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	48	48½
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	113½	115
General Mortgage, 5's	2,465,000	1,000	92	93
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	95	96½
Syracuse, N. Y.	1,975,000	100	29	..
Bonds	2,047 000	1,000	99½	100
Washington, D. C	2,600,000	20	375	380
First mortgage 6's	500,000	..	..	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del.	600.000	50	232	..

Advertisers' Index.

GAS ENGINEERS. Page

Wm. Henry White, New York City 695
Fred. Bredel, Milwaukee, Wis. 682
Geo. R. Rowland, New York City 682
The Western Gas Construction Co., Fort Wayne, Ind. 660
Humphreys & Glasgow, New York City 693
David Leavitt Hough, New York City 692
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 682
Baxter & Young, Detroit, Mich. 692
United Gas Improvement Co., Philadelphia, Pa. 687
James T. Lynn, Detroit, Mich. 692
A. E. Boardman, Brevard, N. C. 692
The Jeffrey Manufacturing Co., Columbus, O. 690

GAS WORKS APPARATUS AND CONSTRUCTION.

Continental Iron Works, Brooklyn, N. Y. 694
Delly & Fowler, Philadelphia, Pa. 656
Kerr Murray Mfg. Co., Fort Wayne, Ind. 692
Stacey Mfg. Co., Cincinnati, Ohio. 695
Bartlett, Hayward & Co., Baltimore, Md. 693
Davis and Farnum Mfg. Co., Waltham, Mass. 692
R. D. Wood & Co., Philadelphia, Pa. 694
Isbell-Porter Company, New York City 694
Fred. Bredel, Milwaukee, Wis. 682
United Gas Improvement Co., Philadelphia, Pa. 687
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 682
The Western Gas Construction Co., Fort Wayne, Ind. 660
Humphreys & Glasgow, New York City 693
Logan Iron Works, Brooklyn, N. Y. 696
Riter-Conley Mfg. Co., Pittsburg, Pa. 695
Baxter & Young, Detroit, Mich. 692
G. Shepard Page's Sons, New York City 692
James T. Lynn, Detroit, Mich. 692
A. E. Boardman, Brevard, N. C. 692
Christopher Cunningham, Brooklyn, N.Y. 689
The Jeffrey Manufacturing Co., Columbus, O. 690
Quintard Iron Works, New York City 694
The Connersville Blower Company, Connersville, Ind. 697
Lloyd Construction Co., Detroit, Mich. 682
Connelly Iron Sponge and Governor Co., New York City 643

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md. 693
United Gas Improvement Co., Philadelphia, Pa. 687
Burdett Loomis, Hartford, Conn. 694
Economical Gas Apparatus Construct'n Co, Toronto, Ont. 682
The Western Gas Construction Co., Fort Wayne, Ind. 660
Humphreys & Glasgow, New York City 693
B. E. Chollar, St. Louis, Mo. 678

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Philadelphia, Pa. 694
Continental Iron Works, Brooklyn, N.Y. 694
Logan Iron Works, Brooklyn, N. Y. 696
Riter-Conley Mfg. Co., Pittsburg, Pa. 695
The Western Gas Construction Co., Fort Wayne, Ind. 660

PRODUCER POWER PLANTS.

R. D. Wood & Co., Philadelphia, Pa. 694

TAR AND CARBONIC ACID EXTRACTOR.

The Western Gas Construction Co , Fort Wayne, Ind. 660

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich. 698
The Western Gas Construction Co., Fort Wayne, Ind. 660

GAS METERS.

John J. Griffin & Co., Philadelphia, Pa. 700
American Meter Co., New York and Philadelphia. 699
Helme & McIlhenny, Philadelphia, Pa. 699
D. McDonald & Co., Albany, N.Y. 697
Nathaniel Tufts Meter Co., Boston, Mass. 698
Maryland Meter and Mfg. Co., Baltimore, Md. 698
Metric Metal Co., Erie, Pa. 699
Keystone Meter Co., Royersford, Pa. 698
Detroit Meter Company, Detroit, Mich. 659

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia. 699
John J. Griffin & Co., Philadelphia, Pa. 700
D. McDonald & Co., Albany, N. Y. 697
Helme & McIlhenny, Philadelphia, Pa. 699
Nathaniel Tufts Meter Co., Boston, Mass. 698
Keystone Meter Co., Royersford, Pa. 698

PREPAYMENT METER ATTACHMENTS.

Reeves Mfg. Co., New Haven, Conn. 677

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City 684
R. D. Wood & Co., Philadelphia, Pa. 684
Warren Foundry and Machine Co., New York City 684
Donaldson Iron Co., Emaus, Pa. 684
Christopher Cunningham, Brooklyn, N.Y. 689

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N.Y. City 684

GAS TAPPING MACHINES.

George Light, Dayton, O. 684
H. Mueller Manufacturing Company, Decatur, Ills. 681

GAS COALS.

Perkins & Co., New York City 690
Westmoreland Coal Co., Philadelphia, Pa. 691
Berwind-White Coal Mining Co., New York and Phila. 690

CANNEL COALS.

Perkins & Co., New York City 690

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills. 691
The Western Gas Construction Co., Fort Wayne, Ind. 660
The Jeffrey Manufacturing Co., Columbus, O. 690
C. W. Hunt Company, New York City 681
Akron Cultivator Co., Akron, O. 678

CHARGING BARROWS & COAL WAGONS.

Akron Cultivator Co., Akron, O. 678

GAS ENRICHERS.

Standard Oil Co., New York City 691
The Sun Oil Co., Pittsburg, Pa. 691

COKE CRUSHERS.

C. M. Keller, Columbus, Ind. 691
The Jeffrey Manufacturing Co., Columbus, O. 690

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N.Y. 684
The Connersville Blower Company, Connersville, Ind. 697

ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N.Y. 678

GAS GAUGES.

The Bristol Co., Waterbury, Conn. 690

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 643
Isbell-Porter Co., New York City 694
R. D. Wood & Co., Philadelphia, Pa. 694

CEMENTS.

C. L. Gerould, Galesburg, Ills 688

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J 688
Adam Weber Sons, New York City 688
Laclede Firebrick Mfg. Co., St. Louis, Mo 688
Cyrus Borgner, Philadelphia, Pa 688
James Gardner, Jr., Co., Pittsburg, Pa 688
Henry Maurer & Son, New York City 688
Baltimore Retort and Firebrick Co., Baltimore, Md. 688
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 688
Brooklyn Firebrick Works, Brooklyn, N. Y. 688
Missouri Firebrick Co., St. Louis, Mo. 688

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. 603
Fred. Bredel, Milwaukee, Wis. 682
J. H. Gautier & Co., Jersey City, N.J. 688
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 688
Adam Weber Sons, New York City 688
Laclede Firebrick Mfg. Co., St. Louis, Mo. 688
Missouri Firebrick Co., St. Louis, Mo. 688

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City 694
Continental Iron Works, Brooklyn, N.Y. 694
Logan Iron Works, Brooklyn, N.Y. 696
R. D. Wood & Co., Philadelphia, Pa. 694
The Western Gas Construction Co., Fort Wayne, Ind. 660

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City 688

INCANDESCENT GAS LAMPS.

Welsbach Company, Gloucester, N. J. 686
General Gas Light Company, Kalamazoo, Mich. 681
D. M. Steward Mfg. Co., Chattanooga, Tenn. 680
Detroit Arc Gas Light Co., Detroit, Mich. 690
Ball Check Light Co., New York City 679
Acorn Brass Works Mfg. Co., Chicago, Ills. 680

BURNERS.

C. A. Gefrorer, Philadelphia, Pa. 680
Wm. M. Crane Co., New York City. 681
D. M. Steward Mfg. Co., Chattanooga, Tenn. 680
Sunlight Lava Mfg. Co., Chattanooga, Tenn. 677
Manhattan Brass Co., New York City. 637
Oscar Wiederhold, Bloomfield, N. J. 637

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn. 680
Sunlight Lava Mfg. Co., Chattanooga, Tenn. 677

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila. 686
Thos. T. W. Miner, New York City. 681

PURIFIERS.

R. D. Wood & Co., Philadelphia, Pa. 694
Stacey Mfg. Co., Cincinnati, O. 695
The Western Gas Construction Co., Fort Wayne, Ind. 660

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 643

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y. 681
R. D. Wood & Co., Philadelphia, Pa. 694
Continental Iron Works, Brooklyn, N. Y. 694
The P. H. & F. M. Roots Co., Connersville, Ind. 683
Isbell-Porter Co., New York City 694
The Western Gas Construction Co., Fort Wayne, Ind. 660
Kerr Murray Mfg. Co., Fort Wayne, Ind 692

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind. 683
Isbell-Porter Company, New York City. 694
Connelly Iron Sponge and Governor Co., New York City 643
Kerr Murray Mfg. Co., Fort Wayne, Ind. 692
The Connersville Blower Company, Connersville, Ind. 697

ELECTRICAL APPARATUS.

Wm. Henry White, New York City. 695

BOILERS, STACKS, TANKS, ETC.

The Hazelton Boiler Company, Rutherford, N.J. 680

PURIFIER SCREENS.

John Cabot, New York City. 690

GAS STOVES.

American Meter Co., New York and Philadelphia. 685
Maryland Meter and Manufacturing Co., Baltimore, Md 698
Keystone Meter Co., Royersford, Pa. 698
Nathaniel Tufts Meter Co., Boston Mass. 698

HOT WATER HEATERS.

The Humphrey Mfg. and Plating Co., Kalamazoo, Mich. 684

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N.Y. 682

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 695
Continental Iron Works, Brooklyn, N.Y. 694
Delly & Fowler, Philadelphia, Pa. 696
Davis & Farnum Mfg. Co., Waltham, Mass. 682
Kerr Murray Mfg. Co., Fort Wayne, Ind. 692
Stacey Mfg. Co., Cincinnati, O. 695
R. D. Wood & Co., Philadelphia, Pa. 694
Logan Iron Works, Brooklyn, N.Y. 696
Riter-Conley Mfg. Co., Pittsburg, Pa. 695

STORAGE TANKS.

Christopher Cunningham, Brooklyn, N.Y. 689

INVESTORS.

W. R. Faben Construction Company, Toledo, O. 680

Gas Analyses of All Sorts and Conditions,

—OR—

Analyses of Solid and Liquid Materials as Well,

That are needed by Gas Companies at any time in the conduct of their business, may be obtained from

DR. W. H. BIRCHMORE,

1421-tf 341 ADELPHI ST., BROOKLYN, N. Y.

Position Wanted

BY YOUNG MAN thoroughly trained in commercial side of gas business.

Address, "J. W."

1431-1 Care this Journal.

SUPERINTENDENT

DESIRES POSITION.

Young man of thorough experience in all departments of the business; coal or water gas. Excellent record. Competent, reliable and energetic.

1432-4 Address, "ECONOMY," care this Journal.

Position Wanted

AS GAS MAKER, by an experienced operator of modern apparatus. Also competent to take entire charge of distribution. Small plant preferred. References.

1431-1 Address, "GAS MAKER," care this Journal.

DRAUGHTSMAN.

YOUNG MAN, 22 years of age, desires position. Specialty, gas works machinery. Seven years' experience.

1431-3 Address, "W. A. M," care this Journal.

WANTED, ERECTORS.

Two erectors, with experience with either coal or water gas apparatus. State experience. Permanent employment. Address,

"CONSTRUCTOR,"

1429-tf Care this Journal.

WANTED,

Second-hand Station Meter, from 60 to 72 inches diameter.

Four Purifying Boxes, 9 feet by 12 feet, or about that capacity.

1416-tf Address, G. M. ROSSMAN, Treas., Keene, N. H.

Purifiers for Sale.

At a bargain. Four boxes, 10 feet by 12 feet by 3½ feet; nearly new. Ten-inch connections and dry centerseal. Write for price and particulars to

PITTSFIELD COAL GAS COMPANY,

1425-tf Pittsfield, Mass.

144

Perfect Tips to every gross bearing the name

SUNLIGHT.

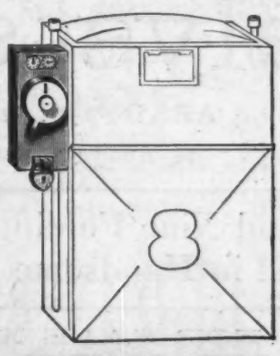
Sunlight Lava Mfg. Co., Chattanooga, Tenn.

THE REEVES PREPAYMENT ATTACHMENT.

SAFETY.
Giving long warning to consumers.

CAPACITY.
$20. Can be prepaid at one time.

SIMPLICITY.
It's construction--all gear work --insuring absolute accuracy.



ADJUSTABLE
Price Dial, instantly set by locked pointer.

ADAPTABLE
To any make of meter.

SECURITY.
Steel Case. Cannot be "beaten" or defrauded.

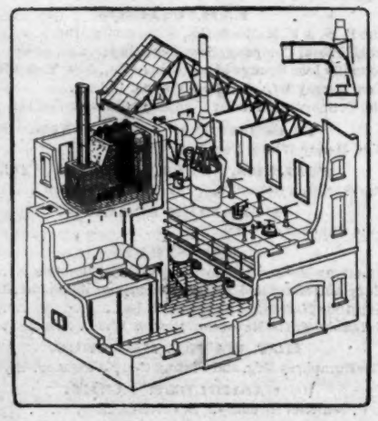
MANUFACTURED BY THE REEVES MFG. CO., NEW HAVEN, CONN.

SELLING AGENTS, THE NATIONAL COSMORAMA CO., NEW HAVEN, CONN.

Economize Heat in Water Gas Plants,

BY UTILIZING A

Green's Economizer,



To absorb the heat now going to waste when you blow through your superheater to heat the feed water for your boilers to the temperature of the steam. This is now being done at the Poughkeepsie Gas Works, Poughkeepsie, N. Y. : : : : :

Write for full particulars how this is accomplished, the saving effected, and the advantages gained, to the

GREEN FUEL ECONOMIZER CO.,
MATTEAWAN, N. Y.

Charging Barrows,
Coal and
Coke Wagons,
Steel Wheelbarrows.

All Specially Adapted for Use in Gas Works.

THE AKRON CULTIVATOR CO.,
MANUFACTURERS,
Akron, O.

Practical Photometry,
By William Joseph Dibdin.

Price, - - - - $3.00.

FOR SALE BY
A. M. CALLENDER & CO.,
No. 42 Pine Street, New York City.

Chollar's System of Gas Purification.

THE PURIFIED GAS REVIVES THE FOULED OXIDE.

THE GAS ENGINEERS' POCKET-BOOK, By Henry O'Connor, Comprising Tables, Notes and Memoranda relating to the Manufacture, Distribution and Use of Coal Gas, and the Construction of Gas Works. PRICE, $3.50.

—FOR SALE BY—
A. M. CALLENDER & CO., 42 Pine Street, New York City.

Practical Handbook on
GAS ENGINES,
With Instructions for Care and Working of the Same,
By G. LIECKFELD, C.E.
Translated with Permission of the Author,
By GEO. M. RICHMOND, M.E.

Price, $1. For Sale by
A. M. CALLENDER & CO.,
No. 42 Pine Street, New York City.

Gas Analyst's Manual,

By JAQUES ABADY, M. Inst. Mech. E.
(Incorporating F. W. Hartley's "Gas Analyst's Manual" and "Gas Measurement.")

Ninety-three Illustrations and Nine Folding Plates.
Bound in Handsome Half Leather. Price, - $6.50.

FOR SALE BY
A. M. CALLENDER & CO., - - 42 Pine Street, New York City.

See that Ball?

I side.

Outside.

Highest Efficiency.

ANY GAS—ANY PRESSURE—INSTANT ADJUSTMENT.

That's "The Story"

Why?

Because the Ball Check spreads and breaks up the gas, also checks the flow, but maintains the initial pressure of gas. The common mantle burners with the Ball Check light up to the top full, mantles of any length up to six inches. **No more long mixing tubes.** The **Ball Check** takes one just **one and one-half inches long.**

Want to try one?

We will send by mail, postage paid, to any gas company or dealer, a sample Ball Check, upon receipt of a dime--they retail for a quarter--that will fit an ordinary cheap mantle burner. It tells its own story in just a minute.

Ball Check Light Company,

16 & 18 Park Place, New York.

STEWARD LAVA TIPS.

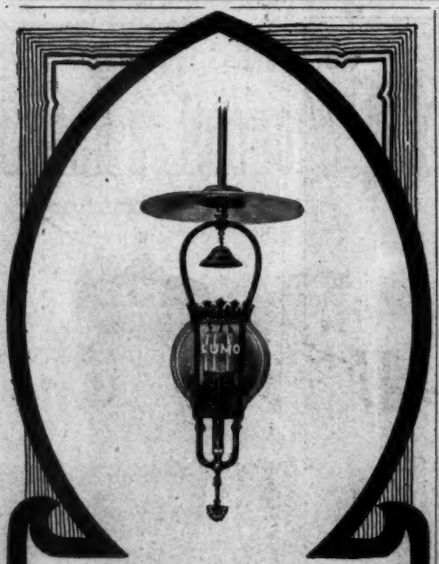
ALL SIZES. ALL KINDS.

Greatest care is used in selection of material and making.

YOU CAN GET ANY QUANTITY PROMPTLY FROM OUR THREE BRANCHES.

THE D. M. STEWARD MFG. CO., (ESTABLISHED 1876.

NEW YORK: 107 CHAMBERS STREET. CHICAGO: 57 WASHINGTON STREET. FACTORY AND GENERAL OFFICE: CHATTANOOGA, TENN



Meet the Electric Light Company on their Own Ground.

The consumer doesn't care what kind of light he uses. His interest is limited to getting the best light for the least money.

THE LUMO GAS ARCS

are now enabling the gas companies to compete successfully with the electric light companies, and are replacing thousands of electric arcs.

They give the same dazzling incandescence; are far more attractive in appearance; cost less to operate, and, better than all, the price is right. We will send a sample lamp on 30 days' trial to any gas company.

Find out why we call it

"THE SCIENTIFIC BURNER."

SEND FOR FULL PARTICULARS.

ACORN BRASS MFG. CO.,

55 N. Green St., Chicago, Ills.

IN THE MARKET.

WE PURCHASE:

Gas properties,
Electric light properties.
Street railway properties.
Also desirable franchises.

W. R. FABEN CONSTRUCTION CO.,

1388-tf 317 St. Claire Street, Toledo, O.

GAS BURNERS,

To burn a given amount at a stated pressure, made to order. Samples furnished. Also, small oil and air valves, slow-feed valves for high pressure, and small brasswork in general.

Drip Pumps, Service Cleaners, Gasfitters' Proving Pumps and Mercury Gauges.

C. GEFRORER & SON,

248 North 8th Street, Philadelphia, Pa.

Utilize Your Gas Liquor.

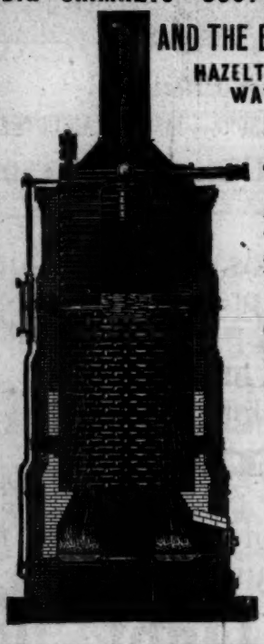
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

BIG CHIMNEYS COST BIG MONEY,

AND THE BUYER PAYS IT.



HAZELTON WATER TUBE BOILERS

Have short chimneys and the BUYER SAVES MONEY.

The heated gases are expelled by the most direct course without the expenditure of power. A long chimney is not needed, but the money saved is.

WRITE FOR FURTHER PARTICULARS.

THE HAZELTON BOILER CO.,

Tele., 6M Rutherford.

Main Office and Works: Rutherford, N. J., U.S.A.

Cable Address: "Pails," Rutherford.

The DETROIT

Force Draft

ARC GAS LAMP.

Durability,
Efficiency,
Simplicity,
Economy.

Perfect Combustion.
No Chimneys to Break.
No Matches Necessary.
Consumes Less Gas.
A Handsome Fixture.
Always in Order.

Our lamp gives 25 per cent. *more light* with 20 per cent. *less gas* than any Arc Gas Lamp now on the market.

TO LIGHT CONSUMPTION WHAT THE GAS RANGE IS TO FUEL. : : : : :

SAMPLE ORDERS *Solicited.*

Manufactured by

The Detroit Arc Gas Light Co.,

67 to 71 Michigan Avenue,

DETROIT, MICH.

PRACTICAL HANDBOOK ON GAS ENGINES, WITH INSTRUCTIONS FOR CARE AND WORKING OF THE SAME,

By G. LIECKFELD, C.E. Translated with Permission of the Author, by GEO. M. RICHMOND, M.E. Price, $1.00.

A. M. CALLENDER & CO., 42 PINE ST., NEW YORK CITY.

BRAY BURNERS

Of Uniform Excellence and Greatest Candle Power.

BEWARE OF IMITATIONS.

WILLIAM M. CRANE CO.,

1131-1133 Broadway, New York,

SOLE AGENTS FOR UNITED STATES.

Have you seen Bray's new "LUTA" burner for acetylene gas?

"THE MINER"

Globe Street and Boulevard Lamps.

Cheapest and Best.

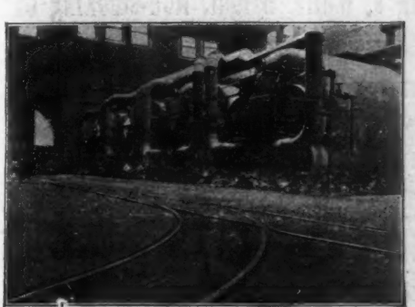
THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

THOMAS T. W. MINER,

821-823 Eagle Av., N. Y.

GAS WORKS BOILER ROOM TRACKS AND FLOORS.



970403 Copyright, 1897, by C. W. Hunt Co.

Cast Plate Boiler Room Floor, with Car Tracks Cast in.

The engraving shows the arrangement of tracks in a boiler house. We furnish cast plate railway track in sections 5 feet long and 28 inches wide. For the remaining space, cast iron floor plates, 13 inches square, make an excellent and durable floor, pleasing to the eye, cleanly, with a good foothold for the firemen, and an almost total absence of wear or repairs. It is without any exception whatever the best and most durable boiler or engine floor in use.

—) MADE BY (—

THE C. W. HUNT CO.,

West New Brighton, Staten Island, N. Y.

THIS IS THE

HUMPHREY GAS ARC LIGHT,

The Best Light in the World

FOR LIGHTING

Stores, Churches, Halls or any large indoor areas.

Guaranteed to give a greater volume of light, better diffused and steadier than an electric arc.

A Complete Revolution in Gas Lighting.

A sample lamp sent on 30 days' trial to any Gas Company.

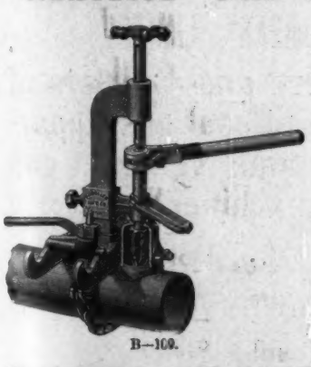
This lamp is thoroughly protected with both Mechanical and Design Patents. Imitation of this Design and Construction will be prosecuted.

Manufactured by the

General Gas Light Co.,

KALAMAZOO, MICH.

Mueller Gas Main Tapping Machines.



B—109.

SOME tapping machines are whales on paper, but only Jonahs in the ditch.

We give you 30 days to try the **Mueller.** If it raises a rumpus throw it overboard at our expense.

Catalogue 3-B describes five different machines.

MADE ONLY BY

H. MUELLER MFG. CO.,

DECATUR, ILLS., U. S. A.

THE

Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.

FRED. BREDEL, C.E.

Coal and Water Gas Plants.

OWN SYSTEM.

RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

SOLE UNITED STATES AGENT FOR

ARROL-FOULIS MECHANICAL CHARGING AND DRAWING MACHINES.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

No. 118 Farwell Avenue, · Milwaukee, Wis.

Lloyd Construction Company,

GREENWOOD AVE. AND M. C. R. R.,

DETROIT, MICH.

MANUFACTURERS AND CONSTRUCTORS
OF GAS APPARATUS AND PLANTS.

AMMONIA
IMMERSION
WASHERS.

A new design in which the gas passes under perforated plates and is washed in the suspended water and spray. Built in sections, each section complete. The entire interior accessible for cleaning from the outside.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Engineers and Builders of water and coal gas apparatuses and general gas works machinery. : : :

AMERICAN OFFICES:
269 Front Street, East Toronto, Ont.

LONDON OFFICES:
19 Abingdon St., Westminster, S. W.

CABLE ADDRESS:
"CARBURETED" LONDON AND TORONTO.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,
238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND,

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City

The Advertisement of the

CONNELLY IRON SPONGE AND GOVERNOR COMPANY,

395 Broadway, New York City,

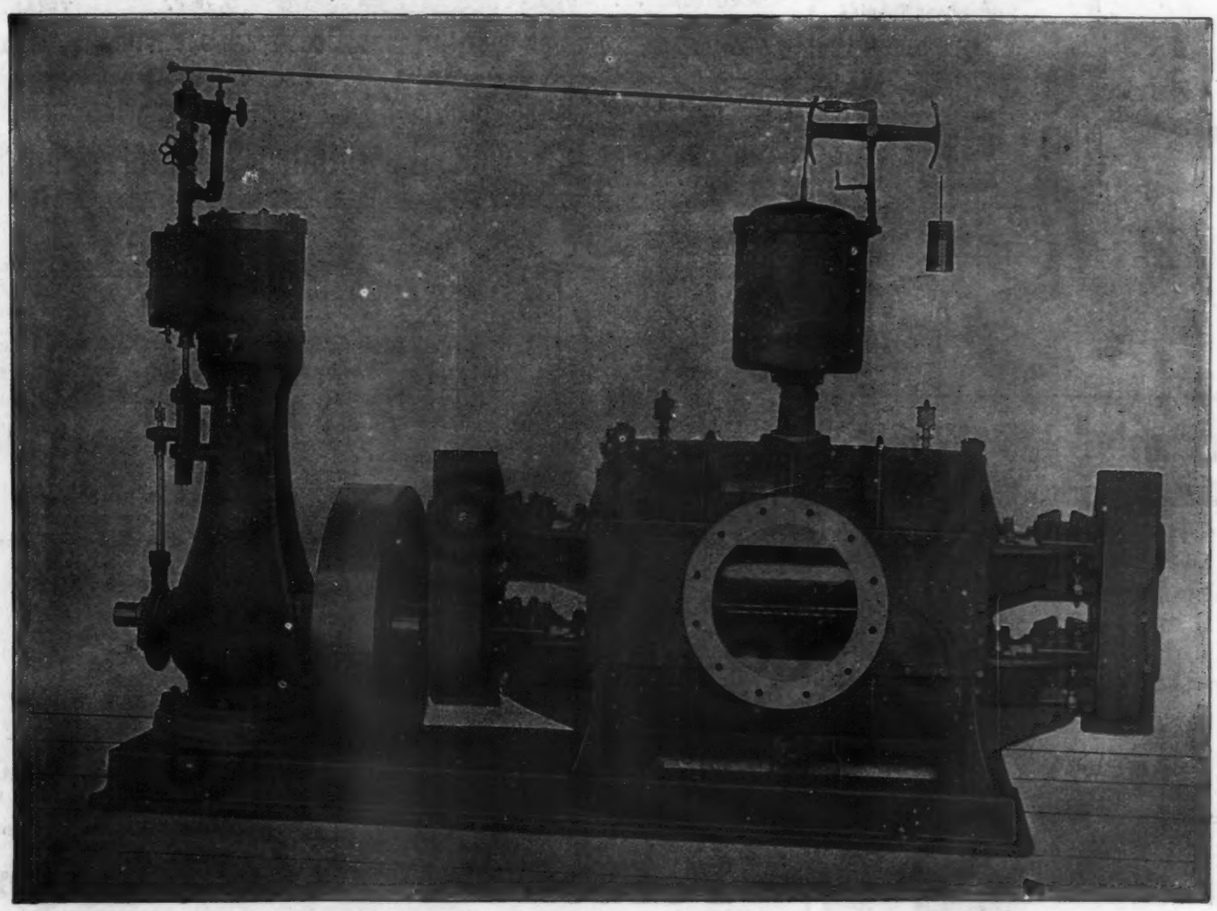
Occupies this Space Every Alternate Week.

ROOTS'

NEW GAS EXHAUSTER.

Always in the lead. Always anticipating the requirements of the trade. Our new Exhauster meets all demands of modern gas making and overcomes all difficulties heretofore experienced.

OUR GAS GOVERNOR IS MAKING FRIENDS EVERY DAY.



P. H. & F. M. ROOTS CO.,

Connersville, Ind. 109 Liberty St., New York.

Eastern Office:

CONNELLY IRON SPONGE AND GOVERNOR CO., 395 BROADWAY, NEW YORK CITY.

"Class" Specials Superior. M. J. DRUMMOND & CO. "Glamorgan" Pig Pitwood

MANUFACTURERS OF

CAST IRON FLANGE GAS and WATER PIPE

GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

GEORGE ORMROD, Manst. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY,

DONALDSON IRON COMPANY. EMAUS, PA.

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

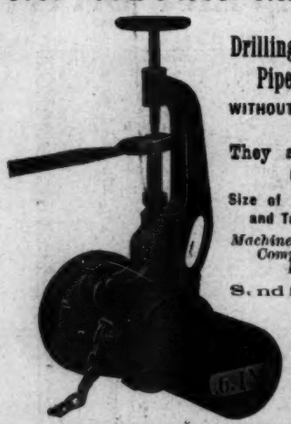
WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars



Geo. Light,

DAYTON, O.

Hughes' "GAS WORKS,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.
Rewritten and Much Enlarged by

WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements.

Price, $1.65.

A. M. CALLENDER & CO., 42 Pine St., N. Y. City.

THE

Valuation of Gas, Electricity and Water Works

FOR ASSESSMENT PURPOSES.

SECOND EDITION.

THOS. NEWBIGGING, M.Inst.C.E., and WM. NEWBIGGING, Assoc.M.Inst.C.E.

With an Appendix of Decided Cases.

Price $2. For Sale by

A. M. CALLENDER & CO.,

42 Pine Street, N. Y. City.

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :

Temporarily during alterations and repairs. : : : :

STOPPERS SENT ON TRIAL.

Address: SAFETY GAS MAIN STOPPER CO., 108 E. 117th St., New York City.

MOST GAS COMPANIES DO SELL, ~ ~ EVERY GAS COMPANY SHOULD SELL

Humphrey Crescent Instantaneous Water Heaters,

A LUXURY and NECESSITY.

This is Our No 2 Heater.

Supplies hot water for domestic use as well as for the bath. It Has No Equal

LIST PRICE NICKEL PLATED, $35.00,

including nickel plated shelf and brackets.

We have many styles, which range in price from our No. 10, at $45.00, to our No. 8, at only $20.00.

Every Heater Guaranteed.

SEND FOR CATALOGUE AND PRICES.

Will send heater on 60 days' trial to any Gas Company.

The Humphrey Manufacturing and Plating Company, KALAMAZOO, MICH., U. S. A.

Parson's Steam Blower

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR USING COAL TAR AS FUEL.

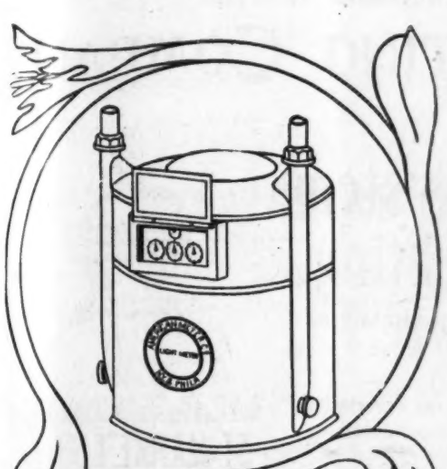
PARSON'S AIR JET TUBE CLEANER,

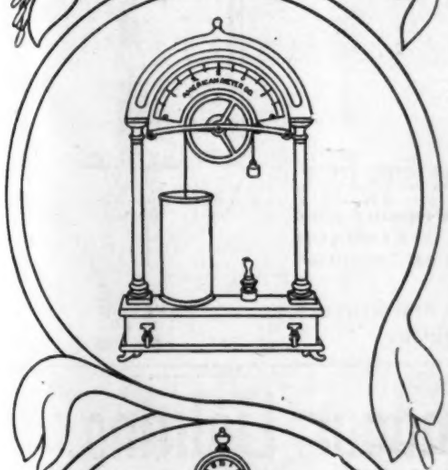
FOR CLEANING BOILER TUBES.

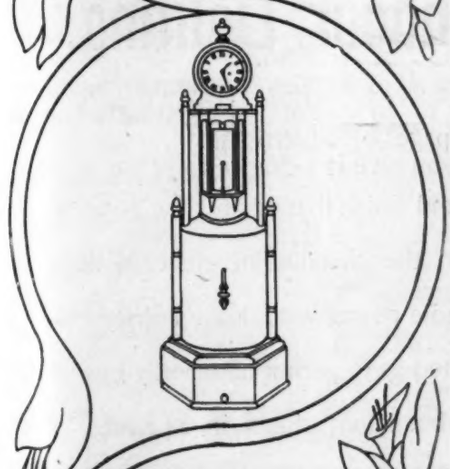
These devices are all first-class. They will be sent to any responsible party *for trial.* No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

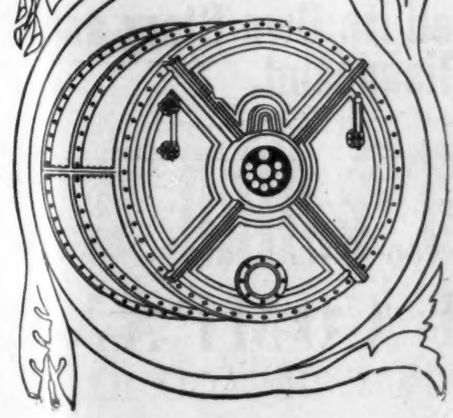
H. E. PARSON, Supt., 457 Putnam Ave., Brooklyn, N. Y.

(Copyrighted, 1894, by the AMERICAN METER CO.)









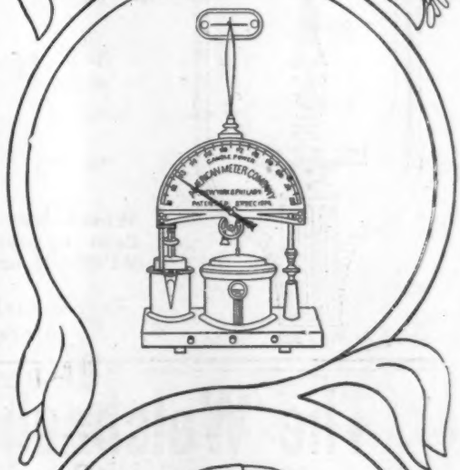
AMERICAN METER CO.

ESTABLISHED 1836. INCORPORATED 1863.

NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.



PUBLIC LIGHTING TABLE.

NOVEMBER, 1902.

Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	5.30 PM	5.30 AM	4.45	5.35
Sun.	2	5.30	5.30	4.45	5.35
Mon.	3	5.30	5.30	4.45	5.35
Tue.	4	7.20	5.30	4.45	5.35
Wed.	5	8.10	5.30	4.40	5.45
Thu.	6	9.00	5.30	4.40	5.45
Fri.	7	10.00	5.30	4.40	5.45
Sat.	8	11.00 FQ	5.30	4.40	5.45
Sun.	9	12.00	5.40	4.40	5.45
Mon.	10	1.00 AM	5.40	4.40	5.45
Tue.	11	2.00	5.40	4.40	5.45
Wed.	12	3.10	5.40	4.30	6.00
Thu.	13	4.20	5.40	4.30	6.00
Fri.	14	No L.	No L.	4.30	6.00
Sat.	15	No L. FM	No L.	4.30	6.00
Sun.	16	No L.	No L.	4.30	6.00
Mon.	17	5.10 PM	7.50 PM	4.30	6.00
Tue.	18	5.10	9.00	4.30	6.00
Wed.	19	5.10	10.10	4.25	6.00
Thu.	20	5.10	11.10	4.25	6.00
Fri.	21	5.10 LQ	12.20 AM	4.25	6.00
Sat.	22	5.10	1.30	4.25	6.00
Sun.	23	5.10	2.30	4.25	6.00
Mon.	24	5.10	3.30	4.25	6.00
Tue.	25	5.10	4.30	4.25	6.00
Wed.	26	5.10	6.00	4.20	6.10
Thu.	27	5.10	6.00	4.20	6.10
Fri.	28	5.10	6.00	4.20	6.10
Sat.	29	5.10 NM	6.00	4.20	6.10
Sun.	30	5.00	6.00	4.20	6.10

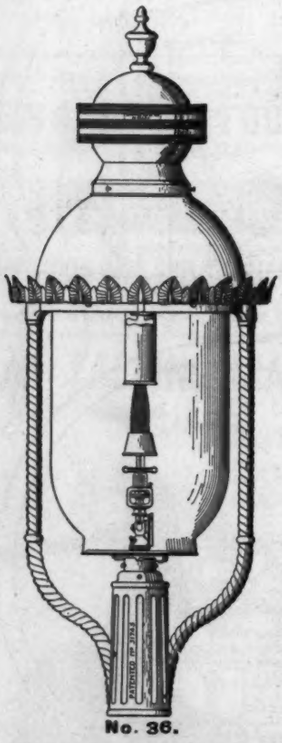
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

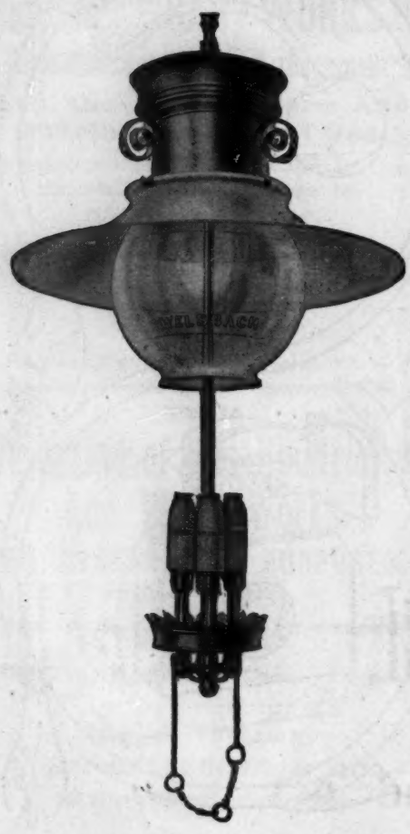
IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.

No. 38.

The Welsbach Gas Arc for Indoor Lighting.



The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

1. A mechanical construction and finish that insures the greatest durability.
2. The renewal of mantles and the cleaning of globes without removal of globe.
3. The greatest amount of candle power with least consumption of gas.
4. A by-pass cock so constructed as to permit all or only one mantle burning at a time.
5. A pilot light that consumes but 1 foot of gas in 24 hours. Costs $\frac{1}{10}$ of a cent a day.

Give it a Chance to Tell its Own Story and it Won't Disappoint.

Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

May we Send you ONE Lamp?

WELSBACH COMPANY,

GLOUCESTER, N. J., and CHICAGO, ILL.

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

The capacity of apparatus installed, if operated continuously, is sufficient to make more than the entire amount of artificial gas annually sold in the United States.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY, Prest. DAVID R. DALY, V.-Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

A. H. GUTKES, President. E. L. RICE, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St., Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office: 914, 915 & 916 Wainwright Building, St. Louis, Mo.

ELECTRIC GAS LIGHTING.

HOW TO INSTALL ELECTRIC GAS IGNITING APPARATUS, INCLUDING THE JUMP SPARK AND MULTIPLE SYSTEMS FOR USE IN HOUSES, CHURCHES, THEATERS, HALLS, SCHOOLS, STORES OR ANY LARGE BUILDING. ALSO, THE CARE AND SELECTION OF SUITABLE BATTERIES, WIRING AND REPAIRS.

By H. S. NORRIE.

Price, 50 cents. Orders may be sent to
A. M. CALLENDER & CO., 42 PINE ST., N. Y CITY.

Adam Weber Sons.

Manhattan Fire Brick and Enameled Clay Retort Works.
Works, Weber, N. J.
Main Offices Park Row Bldg., New York.

Modern Recuperative Furnaces.
Standard Fire Brick and Gas Retorts.

Designers and Builders of Chimneys of Perforated ....Radial Blocks....

AGENCIES.
HERBERT B. HAM, 50 Water Street, Boston, Mass.
BAKER ENGINE AND MACHINE CO., 114 N. 3d St., Phila., Pa.
JOHN T. WHEELER, 933-934 Monadnock Bldg., Chicago, Ills.

CYRUS BORGNER CO.
23rd ST. ABOVE RACE PHILADA. PA. U.S.A.
FIRE BRICK AND CLAY RETORTS

ISAAC C. BAXTER, President. —ESTABLISHED 1864.— PETER YOUNG, Sec'y and Treas.

Works, LOCKPORT STATION, PA.

JAMES GARDNER, JR., CO.,

Address all communications to JAMES GARDNER, JR., CO., Box 277, JOHNSTOWN, PA.

Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS

WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 200 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

For orders East of Buffalo, N. Y., or Pittsburg, Pa., freight will be paid to these points.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,
417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies.

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT
LOCUST POINT, BALTIMORE, MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY, AND FIRE CEMENT.

Our Improved Half and Full Depth Benches have been Adopted by Many Gas Companies.

WALDO BROS., 102 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL,
President and General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are the **Exclusive Agents** *for the* **Mitchell Patent Benches,** *Constructed with Half or Full Depth Furnaces, to Burn either Coal or Coke, and Arranged for Front or* **Rear Clinkering.** **The Mitchell** *is the* **Original Coal Firing Bench.** *We also Erect Plain Benches with* **One** *to* **Six Retorts.**

YOUR CORRESPONDENCE IS RESPECTFULLY SOLICITED.

City Office: 411 Olive Street, Continental Bank, ST. LOUIS, MO.

CHRISTOPHER CUNNINGHAM,

PROPRIETOR,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

SCIENTIFIC BOOKS.

ELECTRIC GAS LIGHTING. By H. S. Norrie. 50 cents.

GAS ANALYST'S MANUAL. By J. Abady. $6.50.

COX'S GAS FLOW COMPUTER. $2.50.

FIELD'S ANALYSIS, 1901. $5.

HUGHES' GAS WORKS. $1.65.

POOLE ON FUELS. By Herman Poole. $3.

GAS ENGINEER'S POCKET-BOOK. By Henry O'Connor $3.50.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards. 20 cents.

PRACTICAL TREATISE ON HEAT. By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

HEMPEL'S GAS ANALYSIS, $2.25.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfeld. $1.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $2.

CEMENT: A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

A COMPARISON BETWEEN THE ENGLISH AND FRENCH METHODS OF ASCERTAINING THE ILLUMINATING POWER OF COAL GAS. $1.00.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Kapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $2.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications By John T. Sprague. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 42 PINE ST., NEW YORK.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully Prepared.
For Gas Making or
Heavy Steaming.

A. C. M. AZOY, General Agent, 1 Broadway, New York.

SPECIAL TRAYS FOR IRON SPONGE.
CHURCH'S PATENT TRAYS.
Reversible, Strongest, Most Durable, Most Easily Repaired.

553-557 West Thirty-third St., New York.
We also make the best of
REVERSIBLE BOLTED TRAYS.
SEND FOR BOOKLET.

Bristol's Recording
PRESSURE GAUGE.
For continuous records of
Street Gas Pressure.
Simple in construction, accurate in operation and low in price.
Fully Guaranteed. Send for Circulars.
THE BRISTOL CO.,
Waterbury, Conn.

Silver Medal, Paris Exposition.

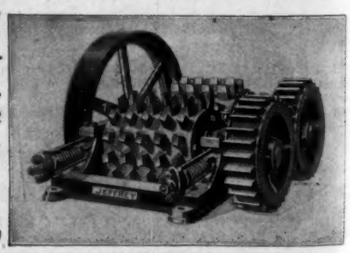
Jeffrey Elevating-Conveying Machinery

Jeffrey Detachable Chain.

FOR HANDLING
COAL, COKE, ETC.

NEW CHAIN CATALOGUE NOW READY. SEND FOR COPY.

Shaking Screens, Dump Cars, Power Transmission Machinery, Chains, Elevator Buckets, Sprocket Wheels, Crushers, Screens, Cable Conveyors, Spiral Conveyors, Etc.



Coal and Coke Crushers.

ADDRESS
THE JEFFREY MFG. COMPANY,
COLUMBUS, OHIO, U. S. A.
NEW YORK : : : CHICAGO : : : DENVER.

The Gas Engineer's Laboratory Handbook,

By JOHN HORNBY, F.I.C. Price, $2.50.

Orders may be sent to

A. M. CALLENDER & CO., 42 Pine St., N. Y.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50. For sale by

A. M. Callender & Co., 42 Pine St., N. Y.

POOLE ON FUELS.

THE CALORIFIC POWER OF FUELS.

By HERMAN POOLE, F.C.S.

Second Edition. Price, $3. For Sale by

A. M. CALLENDER & CO., 42 Pine St., N.Y. City.

BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 42 Pine Street, N.Y.

EDMUND H. McCULLOUGH, President. CHAS. F. GODSHALL, Treasurer. H. C. ADAMS, Secretary. HENRY WHARTON, Assistant Secretary.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J.,
WATKINS (SENECA LAKE), N. Y.

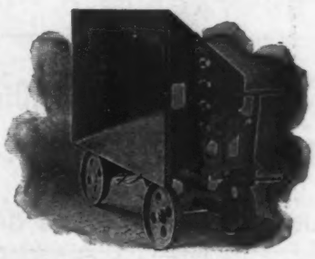
Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,

Chicago, U. S. A.



Tilting Coal and Coke Car.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Tilting Coal and Coke Cars, Breaker Rolls, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

Special Catalogue No. 31 Sent upon Application.

PHILADELPHIA, LINK-BELT ENGINEERING CO.

THE SUN OIL CO.

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company

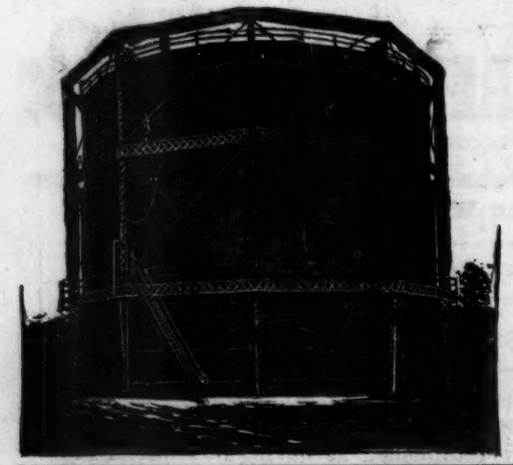
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,
WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors. Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,
CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

GAS PROPERTIES PURCHASED.

OFFICE: WAYNE COUNTY BANK BUILDING, rms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,
Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

JAMES T. LYNN,
GAS ENGINEER AND CONTRACTOR,

Wayne Bank Building, - DETROIT.

GAS PROPERTIES PURCHASED.

Geo. Shepard Page's Sons.
GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

DAVID LEAVITT HOUGH,
Consulting Engineer AND **CONTRACTOR,**

PARK ROW BUILDING, N. Y.

KERR MURRAY MANUFACTURING CO.

Latest Design Rotary Exhauster, With Automatic Governor,

Single or Double-Lift Gasholders,

WITH OR WITHOUT STEEL TANKS.

Storage Oil Tanks, Condensers and Scrubbers.

Purifying Boxes, with Cover-Lifting Apparatus, Center Seal or Valve System Connections and Oxide Elevator.

REVERSIBLE WOOD PURIFYING AND SCRUBBING TRAYS.

Mouthpieces, Standpipes, Etc.; in Fact, All Classes of Ironwork for Benches.

DOUBLE GATE ALL IRON GAS VALVES, 3 TO 36 INCHES DIAMETER.

ALL SIZES OF STREET SPECIAL CASTINGS.

FORT WAYNE, IND.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

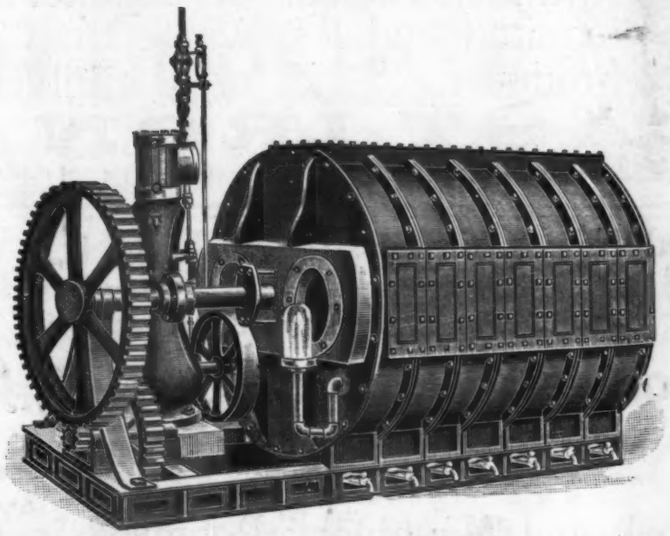
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS.

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

QUINTARD IRON WORKS,

N. F. PALMER.

Foot of 12th St. & East River, New York,

MANUFACTURERS OF

GAS APPARATUS.

Complete Works Erected.

FREDERICK W. FLOYD, Engineer.

ALEX. C. HUMPHREYS, M. E., M. Inst. C. E. ARTHUR G. GLASGOW, M. E., M. Inst. C. E.

HUMPHREYS & GLASGOW,

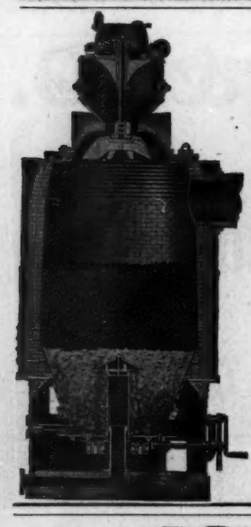
BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

38 VICTORIA STREET, London S. W., England.

CONSULTING GAS AND ELECTRIC LIGHT ENGINEERS.

PROPERTIES PURCHASED.

COMPLETE EXAMINATIONS MADE.



R. D. WOOD & CO.,

400 CHESTNUT STREET, PHILADELPHIA.

—BUILDERS OF—

Gas Power Plants with Producers,

The best Producers for either Bituminous, Anthracite Coal or Lignite. Less labor required and less waste than in any other Producer. Send for Pamphlet. : : : :

CAST IRON PIPE.

HYDRAULIC TOOLS. HYDRAULIC OPERATING VALVES.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

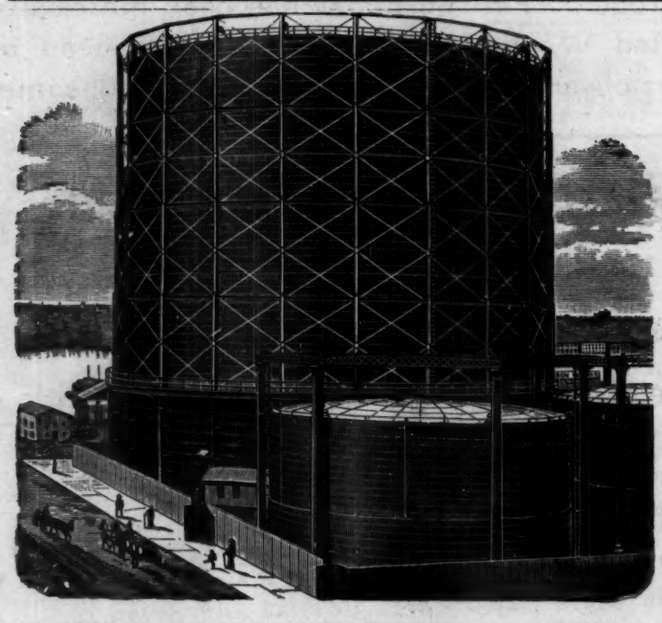
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— **Bridge & Ogden Sts., Newark, N. J.**



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cuttlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

BURDETT LOOMIS, - - Hartford, Conn.

The Gas Engineer's Laboratory Handbook,

BY JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 42 Pine St., N. Y. City.

THE STACEY MANUFACTURING CO.,

The Chollar System of Gas Purification,

WITH DUPLEX BY-PASS VALVE CONNECTIONS.

OFFICES:

No. 239 Mill Street, CINCINNATI, OHIO. 'Phone, West 690.

PLANS, SPECIFICATIONS AND ESTIMATES CHEERFULLY FURNISHED.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

No. 62 Wall Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

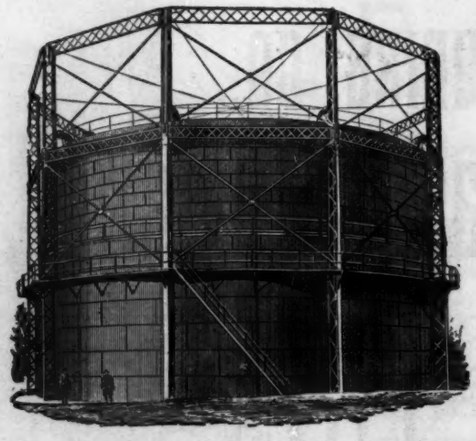
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited. Plans and Estimates Furnished.

1902 DIRECTORY 1902

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 42 Pine Street, New York.



1842 ※ Deily & Fowler, ※ 1902

LAUREL IRON WORKS.

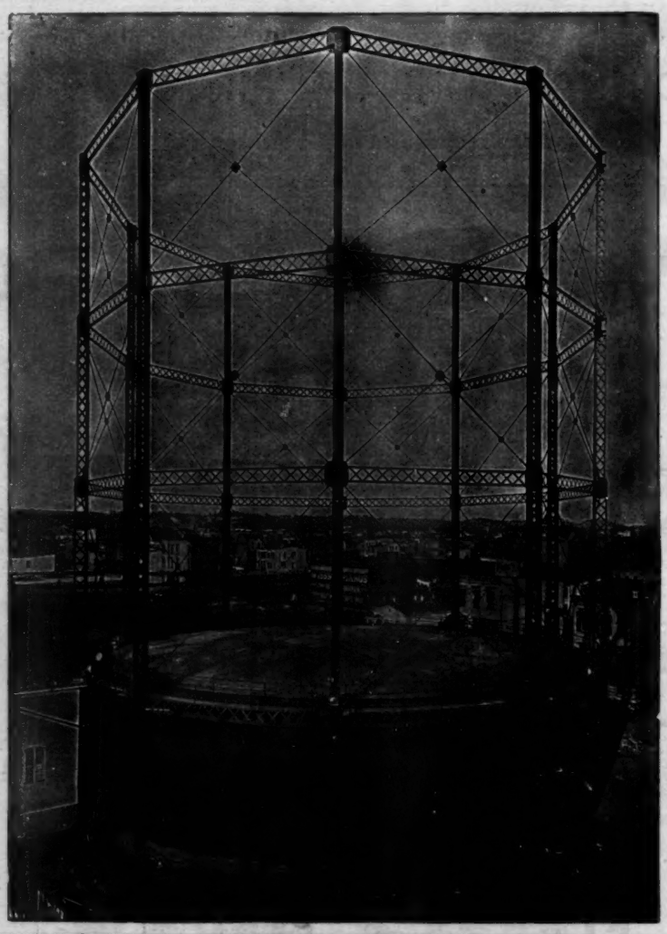
Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu.Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,
CONDENSERS,
PURIFIERS, IRON ROOFS,
Self-Sealing Retort Lids,
AND ALL PARTS OF
GAS WORKS APPARATUS.

Contractors for
Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S
HOT GAS SCRUBBER.

PRACTICAL PHOTOMETRY,

A GUIDE TO THE STUDY OF THE MEASUREMENT OF LIGHT.

By WILLIAM JOSEPH DIBDIN.

With Numerous Illustrations. Price, $3.00.

A. M. CALLENDER & CO., 42 Pine Street, New York City.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 70,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

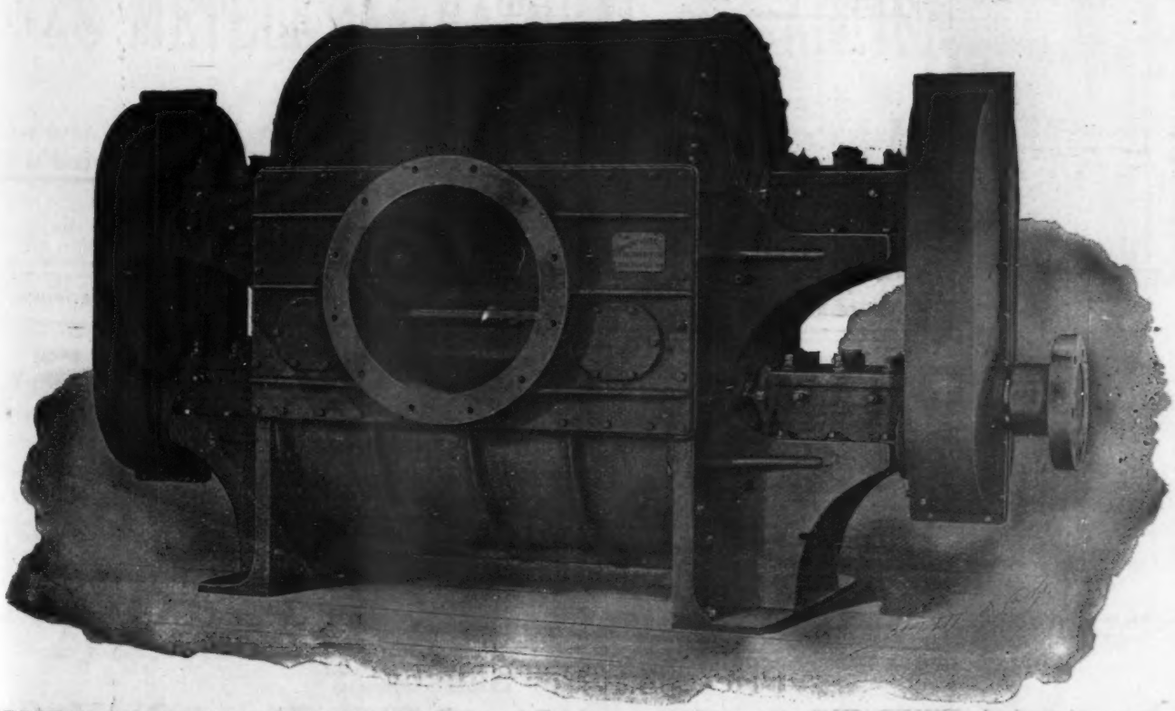
Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | 34 & 36 West Monroe Street, CHICAGO.

THE CONNERSVILLE BLOWER CO.,

MANUFACTURER OF

ROTARY POSITIVE PRESSURE GAS EXHAUSTERS, BLOWERS AND PUMPS.



HORIZONTAL OR VERTICAL, IN CAPACITY RANGING FROM 9,000 to 1 800.000 CU. FEET DISPLACEMENT PER HOUR.

CONNERSVILLE BLOWER CO., Connersville, Ind. EASTERN SALES OFFICE: 95-97 Liberty St., New York City.

NATHANIEL TUFTS METER CO.,

ESTABLISHED 1849.

8 MEDFORD STREET, BOSTON, MASS.

Consumers' Dry Gas Meters.
Station Meters of Any Capacity.

PREPAYMENT GAS METERS.

MARYLAND METER CO.,

BALTIMORE, North and Saratoga Streets. CHICAGO, 88 to 92 Jackson Boulevard.

CONSUMERS' AND STATION METERS, PRESSURE GAUGES, ETC.

SPECIAL ATTENTION GIVEN TO ALL REPAIR WORK

"Have you Seen our Complaint Meter?"

THE KEYSTONE PREPAYMENT

IS——

An Accurate Registrar,
A Sure Shut-off,
An Ideal for Easy Adjustment,
A Model of Simplicity,
A Paragon of Excellence, and
A Mighty Good All-round Meter. Get Acquainted with it.

Keystone Meter Co., ROYERSFORD, PA.

WIESTER & CO., 22 Second Street, San Francisco, Cal.

FIELD'S ANALYSIS

For the Year 1901.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the 33d Year of Publication. Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Company, London.

Price $5. For Sale by

A. M. CALLENDER & CO., - No. 42 Pine Street, N. Y. City.

AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, SAN FRANCISCO.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

A 28-page Pamphlet containing the cream of this Board's decisions as to the proper management of Gas Companies.

Compiled by E. H. YORKE. Price $1.00. Address

A. M. CALLENDER & CO., - No. 42 Pine Street, New York.

The Advertisement of

THE WESTERN GAS CONSTRUCTION COMPANY, Engineers and Builders,

Improved Double Superheater Lowe Water Gas Apparatus—Manufacturers of General Gas Works Machinery—Builders of Gas Works,

FORT WAYNE, IND.,

Occupies this Space Every Alternate Week.

JOHN J. GRIFFIN & CO.,

559 W. 47th St., New York.

1513 to 1519 Race St., PHILADELPHIA, PA.,

34 W. Monroe St., Chicago.

MANUFACTURERS OF

GAS METERS,

Station Meters and Experimental Apparatus of Every Description.

PROMPT ATTENTION GIVEN TO ALL REPAIRING.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 40,000 now in use.

The Positive Prepayment Meter.

Positive Advantages:

The Income is Quick and Sure.

IT IS

Better than C.O.D.,

As Gas is Paid for Before Delivery. : : :

There is Money in it ☞

For the gas man.

IT WILL GET NEW CUSTOMERS.

It will KEEP the ones you have.

Negative Advantages:

No "Deposit" is Necessary to Start Business with a new customer. : : :

NO CUSTOMERS ARE LOST on that account.

No Time Lost Making Out Bills.

No Money Lost on account of Unpaid Bills.

No Disputes on Account of Bills.

THE PREPAYMENT SYSTEM IS PROFITABLE FOR THE GAS MAN AND PLEASANT FOR THE CONSUMER.

NEARLY 100,000 OF THESE METERS ARE IN USE IN THE UNITED STATES.

SEND FOR OUR BOOKLET.